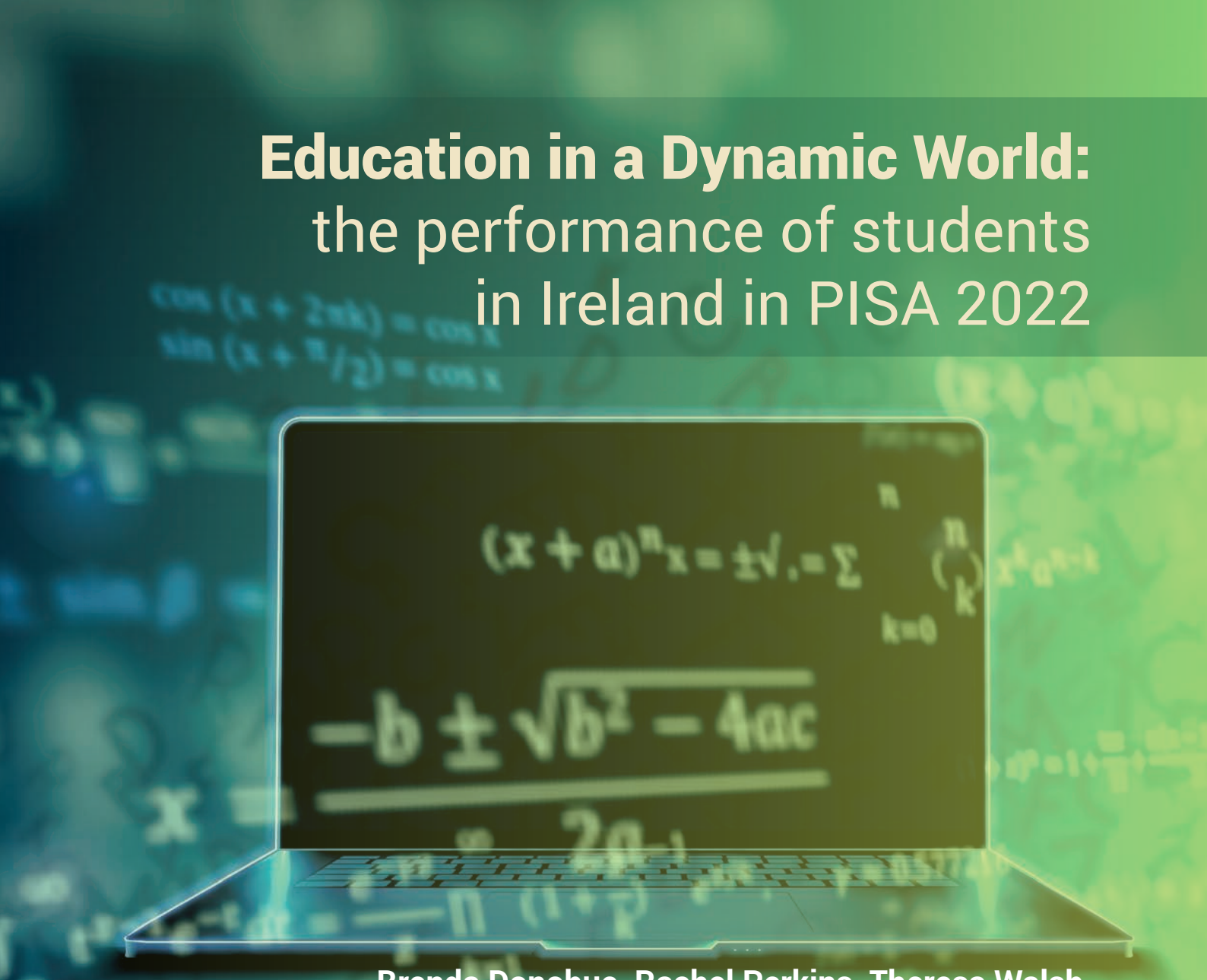
Education in a Dynamic World: the performance of students in Ireland in PISA 2022



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Educational Research Centre

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Foras Taighde ar Oideachas
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Preface

The Programme for International Student Assessment (PISA) is an assessment of the skills and knowledge of 15-year-olds in science, reading literacy and mathematics. It is an initiative of the Paris-based Organisation for Economic Cooperation and Development (OECD). PISA takes place every three years. The first PISA cycle was implemented in 2000 and PISA 2022 is the eighth iteration of the study. In each cycle, one domain is designated a major domain, and the remaining domains function as minor domains. In PISA 2022, mathematics was the major assessment domain, while science and reading literacy were minor domains. An international consortium, led by Educational Testing Service (ETS) in United States, was responsible for the implementation of PISA.

The usual pattern of the PISA cycle was interrupted in this iteration, as the planned implementation of the Main Study in 2021 was delayed by one year to 2022 due to disruptions associated with the COVID-19 pandemic.

A further change in administration took place in Ireland, with Main Study data collection taking place in autumn instead of springtime. In response to reports of a crowded school calendar in springtime, and in an attempt to reduce the burden on schools, the decision was made to move main study testing to the autumn time. This means that data were collected a year and a half later than originally planned, and four and a half years since data were collected in the 2018 cycle of PISA.

This was the third cycle in which testing was administered principally on computer. Following the 2018 cycle, in which adaptive testing was introduced for the first time, in 2022 two domains (reading and mathematics) incorporated a multi-stage adaptive testing design (MSAT).

PISA 2022 was administered in 81 participating countries/economies, including 37 OECD countries, with tests and questionnaires completed by 690,000 students internationally. In Ireland, 5569 students in 170 schools took part, with the majority of participants in Transition Year and Third Year, with smaller proportions in the remaining years.

The OECD has published an assessment framework (2023a), and a technical report is also expected to be released in early 2024 (OECD, in press). Two volumes on the main outcomes of PISA 2022 will be published simultaneously with the launch of the results: *PISA 2022 Results (Volume 1): The State of Learning and Equity in Education (OECD, 2023c), PISA 2022 Results (Volume 2): Resilient Systems, Schools and Students* (OECD, 2023d).

This report, which provides an overview of the main outcomes of PISA 2022 in Ireland, is the first in a series of national reports based on the 2022 data, and will be followed by short, thematic reports on the themes of mathematics, learning in the pandemic, well-being and home environment, and creative thinking.

This report is divided into seven chapters. Chapter 1 provides an overview of the PISA 2022 cycle, and describes its implementation in Ireland. Chapter 2 summarises previous PISA performance in Ireland, and looks at the broader research and policy context. Chapters 3, 4, and 5 describes Ireland's achievement in PISA 2022 in the domains of mathematics, reading and science respectively, and link performance to background characteristics such as ESCS, gender and immigrant status. Chapter 6 reports on students' experiences of learning during the school closures associated with the COVID-19 pandemic. A summary and conclusions are presented in Chapter 7.

Acknowledgements

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In addition, we would like to recognise the invaluable contribution of members of the Department of Education's Inspectorate and ERC temporary staff members who acted as test administrators in the schools during testing, as well as the PISA Quality Monitors.

We gratefully acknowledge the contributions and advice of the PISA National Advisory Committee for their support and wisdom throughout the 2022 cycle (see Appendix A for a list of members).

The PISA 2022 team at the ERC acknowledges the hard work of staff at the international consortium, the Organisation of Economic Cooperation and Development Secretariat, and the PISA Governing Board.

Finally, and most importantly, we would like to thank everybody involved in the data collection on which this report is based. Data collection in this cycle took place in unprecedented circumstances, which posed challenges for all involved. Thank you to all the students who took part in PISA testing in 2020 and in 2022. We would like to extend our thanks to the parents of the students sampled, who completed a Parent Questionnaire. Particular thanks are due to School Contacts who dedicated time and effort to facilitate PISA testing within schools, to Principals, Mathematics Teachers, and Mathematics Co-ordinators who completed School, Teacher and Maths Co-ordinator Questionnaires.

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Additional support: Estrella Veiga-Zarzara and Melda Kavak.

Acronyms and Abbreviations

CBA	Computer-based Assessment
CI	Confidence Interval
DEIS	Developing Equality of Opportunity in Schools
DES	Department of Education and Skills
DLF	Digital Learning Framework
DoE	Department of Education
DT	Digital Technologies
ERC	Educational Research Centre
ESCS	Economic, Social and Cultural Status
ESRI	Economic and Social Research Institute
ETB	Educational and Training Board
ETS	Educational Testing Service
FT	Field Trial
GCM	Global Crises Module
ICT	Information and Communication Technology
IEA	International Association for the Evaluation of Education Achievement
ILSA	International Large-Scale Assessments
JCPA	Junior Cycle Profile of Achievement
MS	Main Study
MSAT	Multi Stage Adaptive Testing
MEG	Mathematics Expert Group
NAMER	National Assessment of Mathematics and English Reading
NCCA	National Council for Curriculum and Assessment
NRBA	Non-Response Bias Analysis
OECD	Organisation of Economic Cooperation and Development
PBA	Paper-Based Assessment
PGB	PISA Governing Board
PIRLS	Progress in International Reading Literacy Study
PISA	Programme for International Student Assessment
PPOD	Primary Online Database
PPS	Probability Proportional to Size
PQM	PISA Quality Monitor
REDS	Response to Educational Disruption Survey
SD	Standard Deviation
SDS	Student Delivery System
SE	Standard Error
SEN	Special Educational Needs
SEC	State Examinations Commission
STEM	Science, Technology, Engineering and Mathematics
TAG	Technical Advisory Group
TIMSS	Trends in International Mathematics and Science Study
TY	Transition Year Programme

Executive Summary

The Programme for International Student Assessment (PISA) is a project of the Paris-based Organisation for Economic Cooperation and Development (OECD), of which Ireland is a member. PISA is an assessment of the skills and knowledge of 15-year olds in mathematics, science, and reading literacy, as well as their preparedness to meet the challenges they may encounter in the future. The first cycle of PISA was implemented in the year 2000, and testing usually takes place every three years. PISA 2022 was an unusual iteration of the project, as the Main Study (originally planned for 2021) was delayed by one year due to disruptions associated with the COVID-19 pandemic. In PISA 2022, approximately 690,000 students participated in PISA across 81 countries/economies internationally. In Ireland, 5569 students participated in 170 schools. Mathematics was the major assessment domain, while science and reading were minor domains. In Ireland, PISA is implemented by the Educational Research Centre (ERC), on behalf of the Department of Education (DoE).

Key Updates and Changes to PISA in 2022

This was the second cycle in which multi-stage adaptive testing (MSAT) was integrated into the assessment design. Building on the design used in 2018 for reading literacy, the mathematics assessment was based on a hybrid linear-adaptive design, where some students followed linear pathways, while the majority were routed to adaptive pathways.

Testing for the Field Trial in this cycle was originally planned to take place in 2020, and Main Study data collection was scheduled for 2021. However, the arrival of the COVID-19 pandemic in 2020, disrupted the planned 2020 Field Trial internationally and ultimately caused the data collection for the Main Study to be postponed to 2022.

In Ireland, PISA testing has traditionally been conducted in spring (usually in the months of March and April) in both the Field Trial and Main Study. However, in an effort to reduce the burden on schools in the busy spring period leading up to the state examinations while maintaining high response rates, testing was moved to an autumn administration (in the months of October and November) for the Main Study in 2022.

Implementation of PISA 2022 in Ireland

Main Study testing for PISA 2022 took place between October and early December in Ireland. A representative sample of 170 schools was selected to take part. Of these, 169 of the original schools and one replacement school took part, giving a weighted school response rate of 100%. Within each school, up to 46 students who met the age criterion were randomly selected, and divided into two groups for testing. In total, 5,569 students participated in the assessment, resulting in a weighted student response rate of 76.8%. As PISA is an age-based assessment, rather than grade-based, the move to autumn testing resulted in a shift in the distribution of students across year levels compared to previous cycles, with the following percentages in the 2022 Main Study – First and Second Year (0.2%), Third Year (26.1%), Transition Year (57.0%), Fifth Year (16.2%), and Sixth Year (0.5%). Of participating students, 48.7% of students were female, while 51.3% were male (weighted percentages). While the majority of students tested in PISA 2018 were in Third Year at the time of testing (61.6%), in 2022 most students participating were in Transition Year (57.0%).

As in the 2015 and 2018 cycles, the PISA assessment and questionnaires were administered on computer only in Ireland. Laptops were provided and transported to schools by the ERC for the purposes of the assessment. Test sessions were administered in schools by members of the Inspectorate of the DoE, and by staff of the ERC, supported by technical support personnel.

The PISA 2022 cycle, like previous cycles, consisted of a two-hour computer-based test of the core domains of mathematics, reading and science, followed by a number of questionnaires that required about 55 minutes to complete. Principals and teachers of mathematics were asked to complete questionnaires online and on paper respectively. Parents of students were also asked to complete a paper-based questionnaire. The data from test and questionnaire items were processed and scaled by the OECD contractors, and appropriate weights applied. Creative Thinking was the 2022 innovative domain, and while Ireland did not take part in the cognitive element, creative thinking questionnaire items were administered to students in Ireland as part of the Student Questionnaire. These data will be published by the OECD in 2024.

Response Rates

PISA measures participation at school and student level, and minimum response levels are specified in both categories. While Ireland achieved a weighted school response rate of 100% in 2022 (which surpassed the required threshold), the student response rate achieved was 76.8% - lower than the minimum final weighted response rate of 80% required. Consequently, Ireland conducted a Non-Response Bias Analysis (NRBA). This analysis found that there is likely to be a small level of upward bias in the achievement estimates for PISA 2022 in Ireland, meaning that the PISA estimates for Ireland in 2022 may have been somewhat lower if all selected students had taken part. It should be noted however, that the bias associated with trend comparisons is likely to be smaller if scores for Ireland from previous cycles are biased in the same direction (as is the case in PISA 2015, where a minimal upward bias was also observed). Details of Ireland's NRBA can be found in Donohue et al., 2023.

Other countries/economies also experienced difficulties achieving the minimum specified response rates. Fifteen countries/economies (including Ireland) appear in this report and in the international report with an annotation attached to their data, and the majority of these annotations relate to response rates. Caution must also be used when considering the data from these countries as in some cases the PISA Adjudication Group has advised that there is evidence of upward bias within their samples.

Overall performance on PISA 2022

Ireland's performance in PISA 2022 showed some changes when compared to previous cycles, particularly in mathematics and science. Ireland's performance needs to be interpreted with regard to wider international developments in PISA 2022, as well as with consideration of the upward bias in the estimates for Ireland identified in the NRBA.

On average across OECD countries in PISA 2022, there were significant drops in mathematics and reading performance, and a non-significant decrease in science performance when compared to the 2018 cycle. In Ireland, there was a significant decrease in mathematics, no significant change in reading performance, and a significant increase in science achievement.

The pattern of results for Ireland in 2022 is in line with findings from the most recent cycles of PISA, that is that Ireland has much fewer students performing below baseline proficiency compared to the average across OECD countries and to comparator countries, but that percentages reaching the highest levels in PISA in Ireland are much closer to the OECD average or just below it.

Performance on mathematics in PISA 2022

Students in Ireland achieved a mean score of 491.6 in mathematics in PISA, which is significantly higher than the OECD average of 472.4. Nine countries/economies achieved a mean mathematics score that is significantly higher than Ireland's (Singapore, Macao, Chinese Taipei, Hong Kong, Japan, Korea, Estonia, Switzerland, and Canada), while Ireland's mean mathematics performance does not differ significantly from that of eight countries/economies (Netherlands, Belgium, Denmark, United Kingdom, Poland, Austria, Australia, and Czech Republic,). The remaining 63 economies performed significantly less well than Ireland in mathematics.

Ireland's mean mathematics score in 2022 is a significant 8.0 score points lower than in the 2018 PISA cycle. This decrease in mean mathematics achievement should be considered in the context of similar decreases internationally. In the same period (2018-2022) the OECD mean mathematics score decreased significantly by 14.9 points. Internationally, 41 countries out of 72 countries that can compare results between 2018 and 2022 showed a drop in mean performance in mathematics, and in many cases, the drop exceeded 20 score points. As Ireland's NRBA indicated a likely small upward bias in the achievement estimates, it is possible that the decrease recorded in mathematics achievement could in fact be somewhat larger if Ireland had achieved similar response rates to previous cycles of the study.

Ireland has fewer lower-performing students than the OECD average. In Ireland, 19.0% of students performed at the lowest levels of proficiency in mathematics (i.e. below Level 2), compared to an average of 31.1% across the OECD. Seven, mostly East Asian, countries had lower percentages of students performing below Level 2 than Ireland. On the other hand, the percentage of students in Ireland reaching the highest levels (7.2%) of performance is slightly lower than the OECD average of 8.7%, and 28 countries/economies had greater proportions of top-performing students than Ireland.

Ireland's mathematics performance is also described in relation to four cognitive processes and content area subscales. Students in Ireland perform highest on the interpreting (494.9) and employing (493.6) cognitive process subscales, and somewhat lower on the reasoning (489.8) and formulating (486.8) cognitive process subscales. Ireland's performance on each of the subscales is higher than the OECD average, with a difference of 18.2 score points on the formulating subscale, 21.8 points for employing, 20.5 for interpreting, and 17.1 for reasoning. For the content area subscales, students in Ireland performed best on the uncertainty & data subscale (498.6), followed by quantity (493.6), change & relationships (491.6) and space & shape (474.5). Ireland's performance on each of the content subscales is also higher than the OECD average, with a difference of 24.9 score points for uncertainty & data, 21.8 for change & relationships, and 21.2 for quantity. Ireland's performance on space & shape, however, is much closer to the OECD average with a difference of just 4.0 points.

Male students significantly outperformed female students by almost 13 points in mathematics, on average in Ireland in PISA 2022. The gender difference is larger than the OECD average difference (9.1 points) which is also in favour of males. Two of our comparison countries had a slightly larger gender difference in favour of male students; United Kingdom (14.4 points), and United States (13.3), while just one of our comparison countries (Finland) had a statistically significant difference (5.1 score points) in favour of female students. There was little difference in the percentages of male and female students performing below baseline proficiency in Ireland (18.5% and 19.6%. respectively), but a significantly greater percentage of males than female students in Ireland achieved at the highest levels on the PISA mathematics test (9.6% for males and 4.7% for females). Furthermore, while male students saw a non-significant decline of almost five points in their mathematics performance

since 2018, the performance of female students dropped significantly by almost 12 points and the percentage of female students performing at the lowest levels in PISA increased from about 16% to almost 20% in the same period.

Performance on reading literacy in PISA 2022

Students in Ireland achieved a mean reading literacy score of 516.0, which exceeds the OECD average by 40 points. One country, Singapore, achieved a significantly higher mean reading score than Ireland and four economies (Japan, Korea, Chinese Taipei, and Estonia) obtained mean scores that do not differ significantly from Ireland's. Seventy-five countries and economies had mean scores that are significantly lower than Ireland's.

Ireland's mean reading score in 2022 is 2.1 score points lower than in the 2018 PISA cycle, though this difference is not statistically significant. This stability of performance can be interpreted against a background of the reading results for other countries/economies participating in PISA 2022. On average, across OECD countries, performance in reading declined by a significant 10.3 score points. The indication from Ireland's NRBA that there is a likely small upward bias in the achievement estimates for Ireland means that the differences between 2018 and 2022 may be somewhat larger, and the possibility of a larger decline in reading performance in Ireland cannot be definitively ruled out.

Ireland's relatively strong performance in reading in 2022 is characterised by both a lower-than-average percentage of lower-achieving students and a higher-than-average percentage of top performing students. However, while the percentage of students in Ireland performing at the lowest levels is less than half the corresponding OECD average (11.4% and 26.3%, respectively), the percentage of students at the highest levels is closer to the OECD average (10.3% and 7.2%, respectively). Ten countries/economies had greater proportions of top-performing students than Ireland. There has been no statistically significant change in the percentages of lower- and higher-achieving students in reading in Ireland since 2015.

In line with the results from previous cycles of PISA, female students in Ireland significantly outperformed their male counterparts in reading. This pattern was reproduced internationally in all but two participating countries (Chile and Costa Rica). The gender difference in favour of female students in reading in Ireland has narrowed from 23.2 points in 2018 to 18.3 points in 2022 however, this may partly be due to the greater level of upward bias observed for male students in the 2022 estimates. This is a smaller gender gap than the corresponding OECD average of 24.2 points in 2022, although both are significant. Just over 14% of male students in Ireland performed below baseline level in reading, which was significantly greater than the corresponding percentage of about 8% for females. On the other hand, a slightly greater percentage of female than male students achieved the highest proficiency levels (11.2% compared to 9.4%).

Performance on science in PISA 2022

Students in Ireland achieved a mean PISA 2022 science score of 503.8 which is significantly higher than the OECD average of 484.6, by 19.2 score points. Nine countries/economies had a mean science score significantly higher than Ireland (Singapore, Japan, Macao, Chinese Taipei, Korea, Estonia, Hong Kong, Canada, and Finland). Eight were not significantly different from Ireland (Australia, New Zealand, Switzerland, Slovenia, United Kingdom, United States, Poland, and Czech Republic), and the remaining 63 countries/economies had significantly lower mean science scores than Ireland.

Ireland's mean science score in 2022 is 7.7 score points higher than in the 2018 PISA cycle, and this difference is statistically significant. This can be interpreted against the background of international achievement, as science performance remained broadly stable in many countries/economies between 2018 and 2022, and the OECD average recorded a non-significant drop of 2.4 score points. Although science achievement in Ireland showed significant improvement since 2018, this should be interpreted with consideration of Ireland's NRBA, which indicated that there is a likely small upward bias in the estimates.

In Ireland, considerably fewer students performed below baseline proficiency in science (15.6%) compared to the OECD average (24.5%), while the percentage of students performing at the highest levels in PISA in Ireland is the same as at the OECD average (both 7.5%). Just eight countries had lower percentages of students performing below baseline proficiency than Ireland, while 22 had greater proportions of top-performing students. Looking at trends, while there were some small fluctuations in the percentages of lower-achieving students in science in Ireland between 2015 and 2022, these differences are not statistically significant, meaning that the percentages of lower-achieving students in science have been relatively stable since 2015. On the other hand, there was a drop in the percentage of the highest performing students in Ireland between 2015 and 2018, followed by an increase between 2018 and 2022. This means that the percentage of students reaching the highest levels in PISA is significantly higher in 2022 than in 2018 but does not differ from 2015.

No significant gender differences in overall science performance in Ireland were observed in 2022. Male students obtained a higher mean science score than female students in Ireland, although the difference (5.6 points) was not statistically significant. While no significant gender differences were observed, it is noteworthy that there was a significant increase of about 11 points in science, on average for male students in Ireland between 2018 and 2022, but no significant change was observed in the average science score of female students in the same period. As with reading and mathematics, the magnitude of gender differences for science varies across the performance distribution. In a similar pattern to that found for mathematics, the greatest differences are amongst the highest-achieving students and are in favour of male students. Similar percentages of male (16.1%) and female students (15.0%) are performing below the baseline level of proficiency in science (i.e., Level 2), while significantly more male (9.5%) than female students (5.5%) reached the top levels of proficiency (Levels 5 and 6).

Student's immigrant background and Economic, Social, and Cultural Status (ESCS)

PISA measures students' Economic, Social and Cultural Status (ESCS) using an index based on variables including parental occupation, highest level of parental education, and home possessions, which is used as a proxy for family wealth. On average, students in Ireland reported having a considerably higher ESCS than their counterparts across OECD countries (0.33 compared to 0.00). Furthermore, 13.0% of the variance in mathematics performance in Ireland is explained by ESCS compared to 15.5% at the OECD average, indicating that the relationship between ESCS and mathematics performance is slightly weaker in Ireland than on average across OECD countries. Similar patterns can be observed in reading and science.

International results show that non-immigrant students tend to outperform immigrant students in all PISA subjects in most (but not all) countries. However, this gap in performance is mainly attributable to socio-economic differences and the linguistic barriers that commonly face immigrant students. In Ireland, 17.4% of students have an immigrant background, compared to 12.9% on average across

OECD countries. Immigrant students in Ireland reported significantly lower ESCS than non-immigrant students, though the difference in ESCS between immigrant and non-immigrant students is narrower in Ireland (-0.22 scale points) than on average across OECD countries (-0.38 scale points). On average, immigrant students in Ireland performed significantly less well in mathematics than non-immigrant students (a difference of 8.2 points). However, the difference in mathematics performance between immigrant and non-immigrant students in Ireland (8.2 points) almost completely disappears (to 0.2 points) when students' socioeconomic status and language spoken at home are accounted for. In reading, the performance difference between non-immigrant and immigrant students in Ireland for reading (13.0 score points in favour of non-immigrant students) is statistically significant but smaller than the OECD average difference (39.3 score points in favour of non-immigrant students). However, in science, a very small and non-significant difference of almost four points is observed comparing immigrant (502.6) and non-immigrant students in Ireland (506.4).

PISA students' reported experiences of learning during COVID-19

The PISA 2022 Main Study took place directly after a time of unprecedented disruption for schools and students and many schools within countries and regions were still dealing with many of the aftereffects of the COVID-19 pandemic when testing took place. In response to these disruptions, a new module (referred to as the Global Crises Module) was introduced into the Student and School questionnaires for PISA 2022, and gathered information on the effect the pandemic had on teaching, learning, and on students' lives. About 70% of more of students in Ireland reported receiving a range of supports from their school every day or almost every day such as having live virtual classes, being sent assignments by their teacher, or having materials uploaded to a school learning platform, compared to about half of students or fewer across OECD countries. When asked whether they received help and support from their families during remote learning, in Ireland students' reports were broadly similar to the reports of students on average across the OECD, although slightly fewer students in Ireland reported receiving help to create a learning schedule (57.1% of students reported never receiving such help from family compared to an OECD average 45.5%), which is perhaps reflective of the relatively high level of learning supports provided by schools in Ireland.

On the other hand, students in Ireland were more likely to report problems with remote learning than their OECD peers. While less than 10% of students in Ireland and on average across the OECD reported difficulties accessing digital devices, the Internet or school supplies, 36.4% of students in Ireland reported experiencing problems motivating themselves to do schoolwork every day or almost every day, compared to 24.8% across the OECD.

Students' reports about how they felt during remote learning were mixed. Over half of students in Ireland agreed or strongly agreed that they enjoyed learning by themselves (52.5%), and that their teachers were well prepared to provide instruction remotely (55.1%), while over 60% reported that they improved their skills in using digital devices for learning (62.7%) and that their teachers were available when they needed help (67.7%). These percentages are broadly similar to the OECD. On the other hand, when compared to the OECD average, a greater percentage of students in Ireland felt that they fell behind in their schoolwork (57.2% compared to 47.6%) and reported that they missed sports and other physical activities organised at school (70.9% compared to 57.0%).

Further Reporting

The OECD published two volumes on the outcomes of PISA 2022 in December 2023, with further thematic reporting planned for 2024-2025. Further national analysis using the PISA 2022 data for Ireland is also planned for 2024-2025 drawing on data on students' attitudes towards mathematics, their use of digital devices, their well-being and home environment, and creative thinking.

Chapter 1:
Overview and Implementation of PISA 2022

Key Points

The main study data collection of the eighth cycle of PISA was due to take place in 2021 but was postponed by one year due to the COVID-19 pandemic.

PISA 2022 was the third cycle administered on computer in Ireland.

In 2022, mathematic literacy was the main assessment domain, science and reading were minor domains.

Ireland did not participate in the cognitive assessment of Creative Thinking, which was the innovative domain in the 2022 cycle, but did administer some questions about students' beliefs about creativity and engagement in creative activities in the Student Questionnaire.

In 2022, multi-stage adaptive testing (MSAT) was used in assessing both mathematics and reading.

Against the background of COVID-19, a number of countries/economies had difficulties meeting the response thresholds set out by the PISA Technical Standards (80% for student response and 85% for school response).

In Ireland, a Non-Response Bias Analysis (NRBA), carried out because the minimum threshold for student response was not met in Ireland, indicated a likely upward bias in the achievement estimates.

The administration of PISA 2022 in Ireland met all other PISA Technical Standards.

1.1 Introduction

The Programme for International Student Assessment (PISA) is an initiative of the Organisation for Economic Co-operation and Development (OECD). PISA measures 15- and 16-year-olds' ability to use their reading, mathematics and science knowledge and skills to meet real-life challenges.[1] As 15- and 16-year-olds are nearing the end of compulsory education in many countries, PISA measures the extent to which this cohort have absorbed and mastered the knowledge and skills necessary for participation in contemporary society. However, PISA does not just measure how students reproduce knowledge, but it also tests how well students can draw on what they have learnt to apply their knowledge to real-life challenges in familiar and unfamiliar settings (OECD 2023a).

[1] The PISA target population in participating countries/economies is defined as students between 15 years and three (completed) months and 16 years and two (completed) months at the beginning of the testing period (Standard 1.1; PISA Technical Standards, OECD, 2022). In Ireland, this meant that students born between 1st August 2006 and 31st July 2007 were eligible to take part in Main Study testing.

PISA is an important study both for individuals and for wider society. Getting an accurate measure of student achievement in the three core PISA domains (mathematics, reading and science) at ages 15/16 can provide a valuable insight into the future. Internationally, poorer achievement outcomes are associated with a higher risk of early school leaving, while conversely, higher achievers are more likely to progress to higher education, and to work in skilled employment by age 25 (OECD, 2018). PISA results, then, can provide an insight into the potential futures of students in Ireland. In addition, findings from PISA inform policy development in Ireland and across OECD and partner countries/economies, helping to shape the education systems of the future.

Currently, the PISA assessment is conducted on a three-year frequency.[2] Participants respond to questions on three core cognitive domains; mathematics, reading and science.[3] They also respond to a number of questionnaires.

The assessment has been administered on computer in Ireland since 2015. Internationally, the majority of participating countries/economies administered PISA 2022 in this way, with only four countries administering PISA on paper instruments (see Table 1.2 for a list of these countries).

In each cycle, one domain is the major domain, with the majority of testing time allocated to it. New items and an updated assessment framework are then developed for the major domain. In 2022, the major domain was mathematics, while reading and science were minor domains. Mathematics was last the major domain in 2012, so the 2022 results provide an opportunity for a more detailed reflection on changes in mathematics outcomes since then.

Table 1.1. Assessment domains across PISA cycles (2000-2022)

Year	Major domain	Minor domains	Innovative/Optional domains
2000	Reading	Mathematics, Science	
2003	Mathematics	Reading, Science	**Cross-curricular Problem Solving**
2006	Science	Mathematics, Reading	**Attitudes towards Science**
2009	Reading	Mathematics, Science	**Digital Reading Literacy**
2012	Mathematics	Reading, Science	**Creative Problem Solving**
2015	Science	Mathematics, Reading	Collaborative Problem Solving
2018	Reading	Mathematics, Science	**Global Competence***
2022	Mathematics	Reading, Science	**Creative Thinking***

Innovative/Optional domains that Ireland participated in are marked in **bold**.
* In the cases of Global Competence and Creative Thinking, Ireland participated in the questionnaire but not the cognitive components of these assessments.

In the 2022 cycle of PISA, 37 OECD countries took part; this does not include Luxembourg, as it did not gather any data for this PISA cycle. This number (37) includes Costa Rica, which joined the OECD in 2021. Further, 26 European Union (EU) countries participated, again not including Luxembourg. Since Brexit in January 2020, United Kingdom is no longer an EU member, and will not be included in the EU averages here, though United Kingdom did participate in PISA 2022. The countries that make up the OECD and EU averages reported here therefore differ from those reported in previous cycles,

[2] After 2025, PISA will shift to a four-year frequency, meaning that the next Main Study after PISA 2025 will take place in 2029.

[3] In the interests of brevity, the terms mathematical literacy, reading literacy, and science literacy are abbreviated to mathematics, reading and science throughout the report.

and this should be taken into account when making comparisons between cycles. In addition, 44 partner countries/economies took part in PISA 2022, bringing the total number of participants to 81 (compared to 79 in the 2018 cycle).

Table 1.2. Countries/economies participating in PISA 2022

OECD Countries		Partner Countries/Economies		
Australia	Japan	Albania	Kosovo	Thailand
Austria	Korea	Argentina	Macao (China)	Ukrainian regions (18 of 27)
Belgium	Latvia	Baku (Azerbaijan)	Malaysia	United Arab Emirates
Canada	Lithuania	Brazil	Malta	Uruguay
Chile	Mexico	Brunei Darussalam	Moldova	Uzbekistan
Colombia	Netherlands	Bulgaria	Mongolia	Viet Nam (PBA)
Costa Rica*	New Zealand	Cambodia (PBA)	Montenegro	
Czech Republic	Norway	Chinese Taipei	Morocco	
Denmark	Poland	Croatia	North Macedonia	
Estonia	Portugal	Cyprus	Palestinian Authority	
Finland	Slovak Republic	Dominican Republic	Panama	
France	Slovenia	El Salvador	Paraguay (PBA)	
Germany	Spain	Georgia	Peru	
Greece	Sweden	Guatemala (PBA)	Philippines	
Hungary	Switzerland	Hong Kong (China)	Qatar	
Iceland	Türkiye	Indonesia	Romania	
Ireland	United Kingdom**	Jamaica	Saudi Arabia	
Israel	United States	Jordan	Serbia	
Italy		Kazakhstan	Singapore	

Source: OECD (in press) Technical Report, Table A1.2
PBA: Paper-based assessment. All other countries/economies administered PISA on computer (CBA).
EU countries are highlighted in blue (Luxembourg did not participate in PISA 2022).
*Costa Rica was invited to become a full OECD member in May 2021.
**Estimates for United Kingdom include data from Northern Ireland, Scotland, Wales and England. Achievement data for Northern Ireland are reported in later chapters of this report.

Internationally, the PISA study is governed by member governments through the OECD. Each member country has a representative on the PISA Governing Body (PGB), which is responsible for making important decisions about the future direction of the study. The implementation of PISA for the 2022 cycle was carried out by a consortium of five different institutions, with the Educational Testing Service (ETS) in United States at the helm. This configuration will change for the 2025 cycle.

In Ireland, responsibility for the implementation of PISA lies with the Educational Research Centre (ERC) on behalf of the Department of Education (DoE). The work of PISA is supported and guided by a National Advisory Committee, which includes representatives from the DoE, the National Council for Curriculum and Assessment (NCCA), the State Examinations Commission (SEC), and subject-matter experts in each of the domains (see Appendix A for more details on membership of the committee).

1.2 The PISA 2022 Assessment

This section describes the different components of the PISA tests and questionnaires administered in 2022, and outlines the key updates and changes made to the assessment in this cycle.

1.2.1 The PISA tests and questionnaires

The 2022 PISA cycle, like previous cycles, consisted of a two-hour computer-based test of the core subjects of mathematics, reading, and science, followed by a number of questionnaires that required about 55 minutes for students to complete in Ireland.[4] Each cognitive domain draws on an individual assessment framework, which guides test development for that domain. These frameworks differ from one another, but retain a similar structure that specifies and describes content or knowledge areas for the test, cognitive processes required of the students, and the contexts in which items are situated.

In the cognitive part of the assessment, students interact with units, organised around stimulus materials, followed by questions based on that stimulus. Depending on the domain in question, stimulus material may consist of texts, charts, illustrations, graphs, spreadsheets, or similar materials. Students then respond to a series of questions related to the presented content. These questions could be multiple-choice or open-response. Multiple-choice items ask students to select a single or multiple responses from a list. These responses are generally computer coded. Open-response items instead, ask students to respond to the item with a written response. These types of responses are generally human coded, though some shorter responses can be computer coded (OECD, 2023a).

1.2.1.1 Major domain

In the PISA 2022 cycle, mathematics was the major assessment domain, with new mathematics items developed, and the majority of cognitive testing time allocated to mathematics. Mathematical literacy in PISA 2022 comprised of new test items based on the 2022 mathematics framework, as well as test content that was carried forward from the 2012 cycle (trend items) (OECD, 2023a).

A new mathematics framework was developed by the OECD PISA Mathematics Expert Group (MEG), updating the mathematics framework that had been in use since 2012 (OECD, 2023a). Following the principles outlined in the new framework, PISA 2022 measures students' 'capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in real-world contexts' (OECD, 2023a, p.22). More detailed information on the mathematics framework can be found in Chapter 3. The development of new items took account of the functionality that computer-based testing offers, reflecting the common use made of mathematical tools in society today. New item formats (e.g. drag and drop) focussed on the interactivity of the platform, presenting students with real-life data (large, sortable datasets) and mathematical models or simulations that students could interact with by changing variable values, and fitting curves to make predictions (OECD, 2023a, p.46).

[4] The Student Questionnaire requires approximately 35 minutes to complete. In Ireland, two international questionnaire options were also administered: the Information and Communications Technology (ICT) Questionnaire and the Well-being Questionnaire. In addition, in Ireland an international Parent questionnaire was completed by parents/guardians, as well as nationally-developed Mathematics Teacher, and Mathematics Co-ordinator questionnaires (all completed on paper).

The mathematics assessment also included a multi-stage adaptive testing (MSAT) design, which built on the adaptive design used for the first time in PISA for reading in 2018. The mathematics MSAT design improves on the 2018 design for reading by using a linear-adaptive hybrid design, and using optimisation methods to assemble the best test possible (see Section 1.2.2 in this chapter for more details on the mathematics MSAT design).

1.2.1.2 Minor domains

In 2022, reading and science were the minor domains. The 2022 reading assessment contained a subset of items from the 2018 assessment of reading. The same MSAT design used in 2018 for reading was implemented again for this cycle, albeit in a reduced form to reflect the smaller item pool used for a minor domain. The reading items used in 2022 contained a mixture of items that were carried forward from 2009 (the second cycle when reading was assessed as a major domain) and items that were newly developed for the 2018 computer-based assessment (the third cycle when reading was assessed as a major domain). These newer items often had interactive elements suited to online testing such as hyperlinks, navigation and dropdown menus.

Science was also a minor domain in the 2022 cycle. A subset of items presented in 2015, when science was last the main domain, were retained for the 2018 and 2022 cycles. As 2015 was the first time computer-based testing was implemented for PISA testing, science items included interactive items, where students simulated experiments and evaluated outcomes with reference to the question asked.

1.2.1.3 Questionnaires

Following the cognitive session, students responded to a number of digital questionnaires, embedded within the testing platform. In Ireland, the questionnaire session included the international core Student Questionnaire, along with the international optional short questionnaires on ICT, and Well-being. Students and school principals also responded to questionnaires associated with the assessment. In some countries, including Ireland, students' parents also completed a paper-based questionnaire (OECD, 2023a). In addition, mathematics teachers in the PISA-participating schools in Ireland were asked to complete a nationally-developed questionnaire. Further information on the PISA 2022 Questionnaire Framework and on additional questionnaires will be reported in follow-up thematic reporting from the ERC in 2024.

Creative Thinking was the PISA 2022 innovative domain. Although Ireland did not take part in the cognitive elements of the Creative Thinking assessment, Ireland did administer creative thinking questionnaire items to students as part of the Student Questionnaire. Findings from the Creative Thinking domain will be reported by the OECD in 2024.

1.2.2 Key updates and changes in the 2022 cycle

A number of key changes can be observed in the PISA 2022 cycle, compared to previous cycles. Firstly, an adaptive testing design has now been implemented for two of the three domains tested. Secondly, the COVID-19 pandemic had a considerable impact on the implementation of the 2022 study. Finally, Ireland made the decision to move to autumn testing for the first time in the 2022 Main Study.

As discussed earlier in this chapter (Section 1.2.1.1) mathematics was the main domain in PISA 2022, meaning more testing time was allocated to mathematics items, and new items as well as a new assessment framework were developed for this domain. PISA 2022 saw a greater emphasis on multi-stage adaptive testing in this cycle, with mathematics and reading both following an adaptive

design. The MSAT design used for mathematics is referred to as a linear-adaptive hybrid design. In this design, 25% of students are directed on a medium-difficulty linear pathway, while 75% of students are routed to the adaptive testing pathways. This differs slightly from the design used for reading where all students are directed to adaptive pathways. For more details on the MSAT design used in 2022, see the *PISA 2022 Technical Report* (OECD, in press).

Secondly, the arrival of the COVID-19 pandemic in 2020 had a significant impact on the administration of PISA 2022 both in Ireland and internationally. Most notably, a decision was made internationally to delay the implementation of the Main Study by one year to 2022 instead of 2021. Every PISA cycle requires participating countries/economies to undertake a Field Trial to test out field operations and try out the new items developed for the main domain. The implementation of the planned 2020 Field Trial was severely impacted by the pandemic, with most countries either collecting data from a much-reduced sample or not testing at all due to school closures. As a result, a second Field Trial was conducted internationally, with most countries collecting Field Trial data in 2021. As Ireland managed to test in about half of sampled schools in March 2020 before school closures were announced, a second round of Field Trial data collection was not carried out. More detail on the implementation of the 2022 Main Study in Ireland can be found in Section 1.3.2 below.

Box 1.1 illustrates the pattern of school closures that took place due to the COVID-19 pandemic in Ireland. Periods where post-primary schools were closed are illustrated in red. As most students that were tested in PISA 2022 Main Study in Ireland were in Transition Year (TY; 57% of students), the column in blue illustrates which grade level this key group were in at each stage of the school closures. The figure shows that students in TY in 2022 were in First and Second Year during the period of the greatest disruption due to COVID-19.

Box 1.1: COVID-19 School Closures

School closures were a key intervention used during 2020 and 2021 to minimise the spread of COVID-19 both in Ireland and internationally.

The chart below indicates in RED when schools were closed and switched to remote teaching and learning.

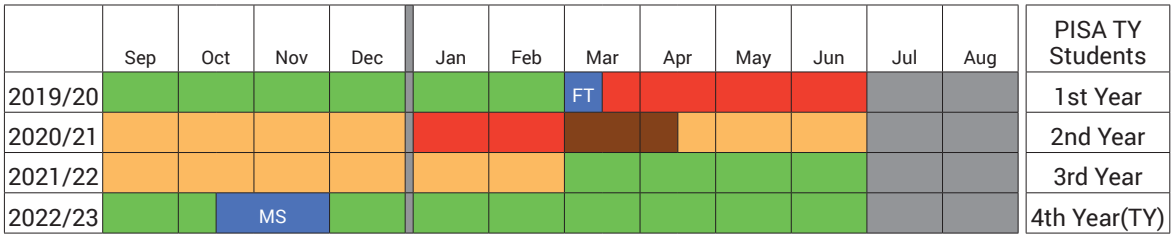
The blocks in BROWN indicate periods when schools were opened on a phased basis (with some, but not all students attending in person).

Those coloured in AMBER indicate when the schools were open with additional COVID-19 restrictions in place (social distancing, mask-wearing etc.). It should be noted that some schools may have had full or partial closures at times during these periods, due to outbreaks among students and/or staff.

Finally, the blocks in GREEN indicate periods where the schools were open with no restrictions in place.

FT indicates the testing period for the PISA 2022 Field Trial in Ireland, while MS indicates the testing window for the Main Study testing in Ireland.

From early spring 2022 in Ireland, the Department of Education approved schools to operate without any restrictions, including the wearing of masks. Therefore, when testing for the PISA MS took place in the autumn term of the 2022/23 academic year, no restrictions were in place at any point. Although there were no government-issued restriction on attending school at the time of testing, the public were generally more conscientious than before the pandemic about attending public places while sick. There were also three known viruses in circulation among large parts of the population at the time.



When testing did take place during the PISA 2022 Main Study, some countries/economies experienced challenges during the data gathering process, and a number of countries (including Ireland) failed to meet the response thresholds specified by the PISA Technical Standards. More details on the implications of this for the interpretation of the data can be found in Sections 1.7 and 1.8 of this chapter.

Finally, testing for PISA in Ireland has traditionally taken place in springtime (usually in the months March and April). For the 2022 cycle of PISA, a decision was made to move the testing period for Ireland to the autumn in an attempt to reduce the burden on schools, whilst maintaining high response rates. Over various PISA cycles, schools and policy-makers have consistently indicated that spring is a crowded and busy time in the school calendar, with practical tests, state exam preparation, project work, and work experience placements often scheduled between March and May. In autumn 2018, the ERC undertook a feasibility study (Denner, 2023) to examine the potential for Ireland to switch from testing in spring to autumn. The study found no statistically significant differences between students' participation rates or overall achievement in reading, mathematics or

science when testing took place in autumn compared to spring. However, as anticipated, there was a noticeable change in the grade distribution of students with the majority of students in Transition Year for autumn testing compared to Third Year for spring testing.

The Main Study data collection in Ireland took place between October and early December 2022. This means that data were collected a year and a half later than originally planned,[5] and four and a half years since data were collected in the 2018 cycle of PISA. Further discussion of the practicalities of testing in this period can be found in Section 1.3.2 of this chapter.

1.3 Implementation of PISA 2022 in Ireland

1.3.1 PISA 2022 Field Trial

As part of the PISA Technical Standards, all participating countries and economies are required to administer a Field Trial ahead of the Main Study, with the dual objectives of testing the quality and validity of new cognitive items at national and international levels, and to assess testing procedures. In Ireland, the Field Trial was scheduled to take place between March and April in 2020. Forty schools were selected in a convenience sample in east, southeast, south, and midland counties. In each school, up to 66 students were randomly selected to participate in the assessment, giving a total of 2608 sampled students.

Administration of the Field Trial in schools began on 2nd March 2020. For the most part, testing was carried out and completed in two parallel sessions on a single morning in each school.[6] During testing, 11 members of the Department of Education's Inspectorate acted as lead test administrators, while an additional 15 staff were employed by the ERC to act as support test administrators.

As mentioned previously in this chapter, due to the arrival of COVID-19 in Ireland in late February and the subsequent spread of the virus, Taoiseach Leo Varadkar announced on the evening of 12th March, that schools were to close with immediate effect.[7] By this time, PISA testing had been completed in 20 of the 40 sampled schools. As school closures continued then for several months, it was not possible to visit the remaining schools within the allocated testing window. Cognitive and questionnaire data was collected and processed for 1058 students who took part in the 20 schools that tested, as well as School, Teacher and Parent Questionnaire data. As the coding of Field Trial items was required to take place in April 2020 in Ireland, during a lockdown when no travel or in-person meetings were allowed, this process was carried out remotely in Ireland for the first time.

Many participating countries/economies testing later in spring 2020 were unable to collect any data from students at all, due to similar school closures and lockdowns occurring globally. Given these circumstances, it was decided to hold a second Field Trial in 2021, with the Main Study being delayed by one year as a result. Countries who had not collected sufficient Field Trial data during 2020 were given the opportunity to carry out a full Field Trial in 2021. As the amount of data that Ireland

[5] Originally, data collection for the PISA 2022 MS was planned to take place in spring, but the decision was made after the FT in 2020 to move to autumn testing for the MS.

[6] It is possible for the cognitive element of the assessment to administered on one day, and the questionnaire element to be administered on another day. However, it is preferable and logistically easier in most cases, for the questionnaire session to be completed immediately after the cognitive element.

[7] Prior to school closures, the Government's public health advice was followed closely by PISA personnel.

collected in March 2020 was deemed acceptable, and the operations had been sufficiently tested, Ireland did not repeat a Field Trial in 2021.

1.3.2 PISA 2022 Main Study

Despite the postponement of testing internationally by one year and the move from spring to autumn testing in Ireland, the procedures followed by the ERC were largely the same as in 2018. PISA was administered in 170 schools (an increase from 157 in 2018), between October and December 2022. In each school, up to 46 students born between 1st August 2006 and 31st July 2007 were randomly sampled to take part. Two test administrators and one technical support person travelled to each school on the date of testing and administered the PISA assessment in two classrooms, or in one large room. Across the testing window, 37 members of the Department of Education Inspectorate acted as lead test administrators, alongside 24 support test administrators hired by the ERC. To facilitate administration, the country was divided up into six regions and teams of test administrators and technical support travelled to schools within particular regions, with the capacity to test in a maximum of 12 schools per day.

The 2022 cycle is the third cycle of PISA in Ireland where the test and Student Questionnaire were administered on computer only. The ERC provided laptops for this purpose onto which two versions of the testing software were uploaded; an English-language version and a second version that allowed students to choose between taking the assessment in English or Irish.[8] The ERC employed a technical support person to setup laptops in each school on the day of testing. Technical support personnel were also responsible for trouble-shooting any technical issues during testing, and uploading the data to a secure server after testing. All sessions were administered on computer using a tailor-made computer platform that does not require Internet access.[9]

PISA Quality Monitors (PQM) were contracted by the PISA consortium to monitor testing procedures in schools in all countries, including Ireland, during the Main Study data collection. Three PQMs carried out monitoring in 15 sampled schools in Ireland. The schools visited by a quality monitor are selected by the PISA consortium to ensure that the assessments are administered in a uniform manner. A further 16 schools were visited by ERC staff for national quality-monitoring purposes.

All test administrators, technical support personnel, and quality monitors were trained by the ERC PISA national team ahead of testing, and received support materials outlining the procedures for testing, the responsibilities of their role, and communication protocols.

In each of the participating schools, the principal nominated a staff member (often a mathematics specialist) to act as the School Contact for the duration of the PISA Main Study. The School Contact liaised with an assigned PISA team member in the ERC and the lead test administrator to carry out key tasks for the planning, preparation and execution of PISA testing in their school. The School Contact was also available on the day of testing to complete some key documentation and to ensure that testing could proceed smoothly, and the DoE offered substitution cover for this and administrative time dedicated to PISA activities.

[8] Each student in a school where Irish is a language of instruction for mathematics was asked to select either English or Irish for the PISA test and questionnaire sessions, and were informed of this option before testing.

[9] Delivery of the test platform (known as the Student Delivery System) varies internationally. While in Ireland, the software is preloaded onto the laptops and run from the desktop, many countries/economies administer the tests via USB sticks that can be plugged into school or student devices.

1.3.2.1 COVID-19 and the PISA 2022 Main Study

The protective measures that were put in place due to the COVID-19 pandemic, including school closures, mandatory facemask wearing, and social distancing rules, were no longer in place during the Main Study. However, the ERC ensured that precautionary measures were put in place for all PISA staff visiting schools and attending training. All laptops and mouses were disinfected after each use, and test administrators and tech support personnel were provided with facemasks and hand sanitisers.

1.3.2.2 Change from spring to autumn testing

The decision to move to autumn testing meant testing took place from mid-October to early-December. One of the impetuses to switch to autumn testing was to avoid busy exam periods and preparation typical during the spring. As anticipated, the scheduling of exams was not reported as a barrier for schools in accommodating PISA testing during the 2022 Main Study. However, two other challenges arose; the verification of student lists for sampling, and the scheduling of testing so as not to clash with TY events.

As Ireland moved to autumn testing, and therefore testing took place relatively early in the academic year, the data used for student sampling was based on enrolment information from the previous school year. While every effort was made to verify the lists with schools before testing, this was not always possible and therefore, in some cases, this led some discrepancies between the student lists and the presence of students within the PISA-sampled schools. This means that a larger number of ineligible students (i.e., students no longer enrolled in the sampled school or students who did not fit within the required birth date range due to errors in the information provided to the ERC) being sampled for this cycle.[10]

In addition, in some cases, the scheduling of TY events, such as trips and work experience, clashed with agreed testing dates. While similar testing date clashes were noted in previous PISA cycles in Ireland, the volume of such clashes was greater in the 2022 Main Study and the effect was more pronounced due to the larger percentage of TY students in the sample (57% in 2022 compared to 28% in 2018). See Section 1.4 of this chapter for more details on this change. When the ERC became aware of such a clash, a new testing date was scheduled in an effort to maximise the number of students participating. In the 2022 Main Study, the initial agreed testing date assigned had to be changed for 22 schools, which was similar to the number in 2018. However, the 2018 MS testing was severely impacted by inclement weather brought by Storm Emma. Of the 22 dates rescheduled in 2018, only three were rescheduled due to reasons not connected to the storm. In contrast, the majority of rescheduled tests in 2022 were due to a clash with a TY event.

1.4 Sampling and Grade Distribution

Sampling in PISA follows a two-stage stratified cluster design. Simply put, schools are selected first, followed by a random selection of students within those schools. Internationally, the samples drawn for each country ensure that the PISA estimates are representative of the school-going population of 15-year-olds in that country. In each country, schools are categorised according to characteristics that are selected by each national centre in consultation with the international sampling experts that

[10] In 2018, 59 sampled students did not participate in PISA as they were ineligible. This increased to 111 in 2022.

form part of the PISA consortium. Schools are then selected from within each category in such a way that the probability of a school being selected is proportional to the number of 15-year-olds in the school. This means that larger schools are more likely to be selected, as PISA aims to select a representative sample of students, rather than a representative sample of schools. This is known as probability proportional to size (PPS).

A representative sample of 170 schools was drawn by Westat, the international sampling experts that form part of the PISA 2022 consortium, to participate in PISA 2022 in Ireland.[11] The ERC provided Westat with information about the Irish school system, and the characteristics of post-primary schools, including school size (i.e., small, medium and large; based on an estimate of the number PISA eligible students in each school), sector (i.e., Secondary, Community/Comprehensive or ETB Vocational schools), gender composition (quartiles based on the proportion of female students), and socioeconomic composition (quartiles based on the proportion of students eligible for the state examinations fee waiver). The sampling frame, and resulting sample, were organised into nine explicit strata based on school sector and size, and within each strata schools were ordered according to the implicit strata of gender and socioeconomic composition. A representative sample of 170 schools was then selected. For each school sampled, two additional schools with similar characteristics were designated as replacement schools, should a sampled school not be able to participate.

Secondly, student names and dates of birth were acquired for each sampled school from the DoE's Post-Primary Online Database (PPOD) and up to 46 PISA-eligible students in each sampled school were randomly selected to participate.[12] It was found that 16 smaller schools in the sample had 46 or fewer PISA-aged students, and consequently all eligible students were sampled in these schools. Selected students belonged to a spread of year groups, ranging from First to Sixth Year.

Of the original 170 schools sampled, one school was unable to participate. Consequently, the assigned replacement school was contacted and agreed to participate. As a result, the final school response rate was 100% after replacement. Ahead of testing, principals were asked to select a suitable test date.

The move to autumn testing in Ireland resulted in a shift in the distribution of PISA-eligible students across year levels. Eligible students participating in PISA are aged between 15 years and three months, and 16 years and two months at the time of testing, irrespective of whether testing takes place in autumn or spring. However, for spring testing, most students in this age range are in Third Year, while for autumn testing, most students in this age range are in TY. In the 2018 Main Study, the majority of sampled students were in Third Year (61.6%), followed by 27.9% in TY. In contrast, the majority of students in the 2022 Main Study were in TY (57.0%), compared to 26.1% in Third Year.

[11] In addition to PISA, the Trends in International Mathematics and Science Study (TIMSS) Main Study, involving students in Second Year, was implemented within the same academic year, in spring 2023. The PISA sample was selected before the TIMSS sample in Ireland, and so overlap control was applied for TIMSS sampling to ensure that no school was sampled for both studies.

[12] This was an increase from up to 44 students in each sampled school in 2018, and up to 42 students in 2015.

Table 1.3 Students completing the PISA assessment in 2022 and 2018				
	MS 2022		MS 2018	
	Unweighted number of students	Weighted percent	Unweighted number of students	Weighted percent
First and Second Year	12	0.2	116	1.8
Third Year	1526	26.1	3533	61.6
Transition Year	3138	57.0	1479	27.9
Fifth Year	868	16.2	449	8.5
Sixth Year	25	0.5	0	0.0

Source: Westat, 2023 and McKeown et al., 2019.

1.4.1 Distribution of students by school type

The distribution of students participating in PISA across different types of schools (i.e., by school sector and gender composition) is similar across the most recent cycles of PISA (Table 1.4). Looking at DEIS status, the percentage of participating students attending DEIS schools is slightly lower in 2022 (21.0%) than in 2018 (24.1%) and is somewhat lower than the percentage of students in DEIS schools at the population level (26.2%).[13]

Table 1.4. Weighted percentages of students by school sector and gender composition, and by school DEIS status participating in PISA 2018, and 2022		
Sector	**2022**	**2018**
Girls Secondary	17.8	21.3
Boys Secondary	16.5	15.0
Mixed Secondary	19.1	17.6
Community/Comprehensive	16.2	17.0
Vocational (ETB)	30.4	29.1
DEIS Status	**2022**	**2018**
Non-DEIS	79.0	75.9
DEIS	21.0*	24.1

1.5 Language of Assessment

Students attending Irish-medium schools or schools with an Irish stream were given the option of sitting PISA in English or Irish during the Main Study.[14] PISA Technical Standard 3.1 specifies that where a language group represents more than 5% of the target population, testing should be

[13] The standard error associated with the percentage of students in DEIS schools (i.e., 21.0%) in PISA 2022 is 2.6, giving a confidence interval from 15.9% to 26.0%. As this confidence interval is very slightly below the percentage at the population level (26.2%) it indicates that the percentage of students attending DEIS schools in the PISA 2022 sample is significantly lower than the percentage in the population.

[14] Reading is only assessed in English, but mathematics and science are assessed through Irish where students choose Irish as the language of assessment.

available in that language in the Field Trial (OECD, 2020). As less than five percent of post-primary students in Ireland receive instruction in the major domain (mathematics in 2022) through the medium of Irish, Irish was not offered as an assessment language during the Field Trial and no Irish-medium schools were included in the Field Trial sample for Ireland.

All new PISA material was translated by an external translator and verified by ERC staff ahead of the Main Study. In English-medium schools, students were presented with the test and instructions in English only. In Irish-medium schools and schools with an Irish-language stream, the software had a language selection option, and each student could choose their preferred language for the assessment. In Irish-medium schools, the script of instructions to students was read in the language that the majority of students planned to take the test in.[15] In all other schools, the script was read in English.

Students cannot change the language for the assessment once they have started; however, they are asked to select their language again when starting the questionnaire. In PISA 2022, 110 students completed the test in Irish, while 53 completed the questionnaire in Irish. This indicates that over half of students who started the assessment in Irish switched to English for the questionnaire.

1.6 Participation Rates

PISA measures participation at two levels, school and student, and specifies minimum response thresholds in both categories. In the 2022 Main Study in Ireland, the final school response rate was 100%[16] meaning that Ireland met the minimum threshold of 85% of sampled schools. A total of 7635 students in Ireland were sampled to participate in PISA 2022 (Table 1.5). Of these, 111 sampled students were deemed ineligible, either due to a date of birth outside the range for eligibility being recorded for the student, or because they were no longer enrolled in the school.[17] Separately, 266 students were exempted on the basis of Special Educational Needs (SEN) or limited proficiency in the test language.[18] Students and parents received information on the study and parents could withdraw their child from participating by completing a non-participation form, which was included with the informational material.

Higher than normal student absences and parental refusals were observed during testing in 2022, when compared to 2018. In 2018, 868 students (12.8% of the sample) did not participate or were absent, while this number was 1689 (22.1% of the sample) in 2022. The parents of 512 students withdrew the participation of their children in 2022 (accounting for 6.7% of the sample). This was an increase on the levels in 2018, when just 75 students were withdrawn from the assessment by their parents.

Table 1.5 presents the unweighted number and percentage of students in each of these categories, while Table 1.6 provides information on students who were exempted according to various categories.

[15] In one instance in a Gaelcholáiste, students in one of the two sessions were inadvertently not offered the language option due to an error with the technical set-up. The assessment defaulted to English for these students.

[16] This is the weighted school response after replacement. The weighted school response rate before replacement is 99.39 (Westat, 2023).

[17] This represents an increase from 59 students in 2018.

[18] PISA encourages participation by students with SEN. However, in some cases, students with SEN (or their parents or teachers) may decide that they will not participate in the assessment. Detailed guidelines are provided to schools ahead of testing about situations in which it may be appropriate to exclude students on SEN grounds.

Table 1.5. Numbers of participating, non-participating/absent, exempted and ineligible students in PISA 2022 sample in Ireland, by gender

	Total Students Sampled	Students – Participated		Didn't Participate/ Absent		Exempted		Ineligible	
		n	%	n	%	n	%	n	%
All	7635	5569*	72.9	1689	22.1	266	3.5	111	1.5
Gender									
Female	3737	2755	73.7	798	21.4	128	3.4	56	1.5
Male	3898	2814	72.1	891	22.9	138	3.5	55	1.4

Source: Westat 2023. The data in the table are unweighted and percentages in the 'all' category are relative to the number of all sampled students i.e., 7635, while the percentages in the gender categories are relative to the number of sampled females and males (i.e. 3737 or 3898).
*The data of 19 students who participated in PISA were excluded, as they did not complete sufficient items to be included.

Table 1.6. Unweighted numbers of within-school exemptions in Ireland in PISA 2022, by category

Category	Functional disability	Intellectual disability/ behavioural or emotional disorder	Limited language proficiency	Specific learning disability (e.g., severe dyslexic difficulties)	Total
Total SEN recorded (including participants)	99	424	98	282	903
Number excluded–unweighted	22	152	53	39	266
Exemptions as a percentage of all sampled students	0.3%	2.0%	0.7%	0.5%	3.5%

The ERC conducted follow-up testing in 26 schools in an effort to increase the number of participating students. However, high rates of absence were also observed during follow-up visits. This is a larger number of follow-up visits compared to 2018, when 17 schools were visited for follow-up testing. As a result, Ireland did not meet the minimum student response rate required in the PISA Technical Standards (OECD, 2020). For countries/economies using computer-based assessment, there is a requirement to assess at least 6300 students (Standard 1.8), and reach a final weighted student response rate of at least 80% (Standard 1.12). In Ireland, 5569 students were assessed, which accounted for a weighted response rate of 76.8% of all sampled students. This constituted a drop in the participation rates of students when compared to 2018 (86.5%).

1.7 Non-Response Bias Analysis

As a result of not meeting the minimum weighted student participation rate in 2022, Ireland was required to conduct a Non-Response Bias Analysis (NRBA). The main purpose of this analysis was to determine the degree to which the students who participated in PISA 2022 in Ireland were different from the planned sample, and to understand if any bias had been introduced into the PISA 2022

estimates as a result of the low student response rate. Internationally, seven countries/economies did not reach the school response rate thresholds, while 10 countries/economies (including Ireland) did not reach the student response rate threshold.[19]

In Ireland, a number of different analyses were conducted on the sample for Ireland. First, the students who actually took part in PISA were compared to the full sample that was selected on key demographic characteristics. As the full sample was selected to be representative of the school-going population of 15-year-olds, this allows us to determine how well the achieved sample represented the 15-year-old population in Ireland. On the whole this analysis revealed that the achieved sample was representative of the population of 15-year-olds, although students in DEIS schools and those taking the Leaving Certificate Applied programme were found to be slightly underrepresented in the final achieved sample (by 0.5 and 0.9 percentage points, respectively).

Second, results from the Junior Cycle written examinations in 2022 were obtained for students who were selected to take part in PISA and used as a proxy for achievement,[20] thus giving an indication of whether the achievement outcomes of students who actually participated in PISA 2022 were likely to differ from those of the full sample that was selected for the study (and therefore, by extension, the overall population of 15-year-olds). As these data were only available for students in TY and some students in 5th Year, the analysis was conducted on a subgroup of the PISA sample only.[21] The results of the analysis show an upward bias of approximately one-tenth of a standard deviation in the achievement estimates of students who took part in PISA, when compared to the broader PISA sample, and there is evidence that the level of bias is larger among male students and students in DEIS schools. This indicates that the achievement estimates for PISA 2022 in Ireland are likely to be higher than they would be had all selected students participated (i.e., had Ireland reached a 100% student response rate). It is estimated that this bias is potentially eight or nine points (for ease of interpretation the mid-point of 8.5 will be used henceforth).

It should be noted, however, that across all cycles of PISA since 2000, Ireland has never achieved a response rate above 88.6% (achieved in 2015). Therefore, there is likely to be some level of bias (albeit minimal bias) in all previous PISA achievement estimates for Ireland and, when comparing the PISA 2022 results to the results from previous cycles, the level of bias associated with the 2022 results is likely to be lower than the estimated 8.5 points. Separate to the analysis carried out on the 2022 sample, the ERC replicated the NRBA analysis using the 2015 PISA data (the cycle in which Ireland achieved its highest response rate), for comparison and an upward bias of approximately 0.05 of a standard deviation (i.e., about half the level found in 2022) was noted. This equates to just over four points on the PISA scale. This indicates that an additional bias of about 4 points is present in the PISA 2022 estimates for Ireland when comparisons are made with the estimates from previous PISA cycles where the highest response rates were achieved (i.e., PISA 2018 and PISA 2015).

More information on the analyses carried out in Ireland's NRBA, and the results of those analyses can be found in (Donohue et al., 2023a).

[19] Four countries/economies conducted a NRBA at both school and student level. They are United Kingdom, Canada, Hong Kong (China) and New Zealand. Malta, Ireland, Scotland, Australia, Panama, and Jamaica conducted a student level NRBA only, while Netherlands, United States, and Chinese Taipei conducted a school-level NRBA only.

[20] While the ERC recognises that the state-certified final written examinations are now just one element of the broader Junior Cycle Profile of Achievement (JCPA), the decision was made to use the scores on the written examinations for English, Mathematics and Science for this analysis due to the availability of data, and the comparability of the data with previous analyses.

[21] This subsample represented 79.9% of the original sample drawn for PISA 2022.

1.8 Caveats When Considering the PISA 2022 Results

Given these indications of an upward bias in the PISA 2022 sample for Ireland, all results presented in this report should be interpreted with appropriate consideration of that bias. The estimates of bias provided earlier in this chapter are drawn from an analysis of a subsample of the PISA 2022 sample. Furthermore, they are based on a composite measure that combines the JC results for English, Mathematics, and Science, where available, and they do not account for any differences between the three domains (mathematics, reading and science); as such, it is not possible to determine the extent to which bias may vary across domains. Therefore, these figures should be treated as broad estimates and used only as a guide. They are provided to facilitate interpretation of the overall mean scores, but should not be treated as an definitive estimate.

When considering subgroup analyses in this report, an additional note of caution is required. Ireland's NRBA provided evidence that the level of bias may vary according to subgroup. In particular, the subgroups of gender and DEIS status show evidence of higher levels of bias in the estimates for male students, and students in DEIS schools. Therefore, subgroup analysis requires a further level of caution in interpretation, given the possibility of different levels of bias within the estimates.

Secondly, 12 countries/economies (including Ireland) appear in this report and in the international report with an annotation attached to their data, and a number of additional countries had difficulty meeting some of the technical standards.. The majority of these annotations relate to difficulties in reaching either school or student response thresholds outlined in the PISA Technical Standards (see Section 1.7 for more details on countries/economies failing to meet response thresholds). In the case of two countries (Viet Nam and Jordan), the annotation refers to unusual cognitive data patterns that deviate from those observed in previous cycles of PISA. The PISA Adjudication Group has recommended that trend comparisons for these two countries be avoided in 2022 (OECD, 2023b; OECD, in press). For comparison, just four countries/economies failed to meet the specified response rates in the 2018 cycle,[22] three countries/economies failed to reach an acceptable school response threshold,[23] while just one country (Portugal) failed to meet the student response threshold.

Some of the 12 annotated countries/economies are referenced in this report, and some are used as international comparators for the Irish results. Caution must be used when considering the data from these countries as in some cases the PISA Adjudication Group has advised that there is evidence of upward bias within their samples. More information on the recommendations of the PISA Adjudication Group, including the recommendation on the interpretation of the data for Ireland, can be found in the PISA 2022 Technical Report (OECD, in press).

1.9 Structure of this Report

This report is divided into seven chapters including this overview on the implementation of PISA 2022 in Ireland. Chapter 2 focuses on the research and policy context against which the results can be better interpreted. This chapter examines the achievement outcomes both from previous

[22] These countries/economies were Portugal, Netherlands, United States, and Hong Kong.

[23] Hong Kong, United Kingdom, and United States.

cycles of PISA, and from other relevant international studies, as well as recent policy and research developments. Chapters 3, 4 and 5 focus on the achievement outcomes for students in Ireland in PISA 2022 in mathematics, reading, and science, respectively. For each of these achievement chapters, the assessment framework is outlined at the outset of the chapter, before mean scores, proficiency levels, and selected student characteristics' relationship with achievement is described. Chapter 6 outlines the findings from the Global Crises Module (GCM), a subset of questions integrated into the PISA questionnaires, asking about school and student experiences of teaching and learning during the COVID-19 pandemic. Chapter 7 includes a summary of the key findings and a discussion of the implications of the findings from PISA 2022 within a research and policy context.

1.10 Interpreting the Analyses in this Report

Throughout the remaining chapters in this report, a number of statistical terms are used. These are defined in Box 1.2. below.

Box 1.2. How to Interpret the Analyses in this Report

OECD average

Throughout the report, reference is made to the OECD average. This is the mean of all OECD countries/economies that have valid data on the indicator in question (e.g., mathematics achievement). The terms 'OECD average' and 'OECD mean' are used interchangeably throughout.

Costa Rica joined the OECD since the last PISA cycle, in May 2021, making it the 38th OECD country. All OECD countries except Luxembourg participated in PISA 2022. Throughout the report, the number of countries in the reported OECD average is 37, unless otherwise noted.

Where performance is compared across PISA cycles, the OECD average represents the number of OECD countries in 2022 that had valid data for the earlier cycles. If a country is omitted from the calculation of the OECD average because of difficulties with the data, this is noted under the relevant tables.

EU average

Where reference is made to the EU average in this report, it refers to 26 countries participating in PISA 2022. This differs from the composition of the EU average in the 2018 cycle, which included Luxembourg (non-participant in 2022), and United Kingdom (no longer a member of the EU), but did not include Spain due to difficulties with the scaling with their data.

Where performance is compared across PISA cycles, the EU average represents the number of EU countries that participated in 2022 and had valid data for the earlier cycles.

Data sources

For international comparisons, results are generally taken from the OECD reports on PISA 2022 (OECD, 2023c; OECD, 2023d) and were verified using a preliminary PISA 2022 international database. Analyses using national variables (i.e., DEIS, sector and gender composition) were conducted by the ERC.

Comparing mean scores

Because PISA assesses samples of students, and students only attempt a subset of PISA items, achievement estimates are prone to uncertainty arising from sampling and measurement error. The precision of these estimates is measured using the standard error, which is an estimate of the degree to which a statistic, such as a country/economy's mean, may be expected to

vary about the true (but unknown) population mean. Assuming a normal distribution, a 95% confidence interval can be created around a mean using the following formula: *Statistic ± 1.96 standard errors.* The confidence interval is the range in which one would expect the population estimate to fall 95% of the time, if many repeated samples were used.

The standard errors associated with mean achievement scores in PISA were computed in a way that takes account of the two-stage, stratified sampling technique used in PISA, with adjustments made to the alpha level for multiple comparisons. The approach used for calculating sampling variances for PISA estimates is known as Fay's Balanced Repeated Replication (BRR), or balanced half-samples, which takes into account the clustered nature of the sample. Using this method, half of the sample is weighted by a K factor, which must be between 0 and 1 (set at 0.5 for PISA analyses), while the other half is weighted by 2-K (OECD, in press).

Standard error

Standard errors (SE) are indications of the level of uncertainty around the observed estimate. Estimates for group-level characteristics are provided in this report, accompanied by an SE. The smaller the SE, the more confidence there is that the observed value reflects the population.

Statistical significance

Statistical significance indicates that a difference between estimates is unlikely to have occurred by chance, and would likely occur again if the survey was repeated (i.e., for significance at the 5% level, the observed difference would most likely be observed again 95 times out of 100). In this report, mean scores are sometimes compared for countries or groups of students. When reference is made to a significant or non-significant difference, a test of statistical significance has been carried out. Within tables, statistically significant differences are generally indicated in bold.

It should be noted 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 and informed judgement should therefore be used in interpreting the results of the statistical tests presented here.

Standard deviation

The standard deviation is a measure of the spread of scores for a particular group. The smaller the standard deviation, the less dispersed the scores are. The standard deviation provides a useful way of interpreting the difference in mean scores between groups, since it corresponds to percentages of a normally distributed population (i.e., 68% of students in a population have an achievement score that is within one standard deviation of the mean and 95% have a score that is within two standard deviations of the mean).

Proficiency levels

In PISA, student performance and the level of difficulty of assessment items are placed on a single scale for each domain assessed. This means that each scale can be divided into proficiency levels and the skills and competencies of students within each proficiency level can be described. In each domain, Level 2 is considered the basic level of proficiency needed to participate effectively and productively in society and in future learning (OECD, 2023a).

OECD Indices

Indices are initially scaled to a mean of 0 and a standard deviation of 1. Where indices are reported, percentages are generated for component items (which may be reported in an appendix table), and index scores are presented in the body of the report.

Chapter 2: Performance, Research and Policy Context of PISA 2022 in Ireland

This chapter describes the performance, research, and policy context against which the PISA 2022 results can be interpreted. The chapter is structured in two distinct sections: the first part looks at Ireland's performance in previous cycles of PISA, alongside other international and national assessments, while the second part reviews recent relevant policies and developments in post-primary education in Ireland.

As outlined in Chapter 1, each cycle of PISA assesses student performance in three separate domains: mathematics, science, and reading. In every cycle, one domain is the main focus, with the majority of testing time allocated to that domain, new test items developed for it, and a new framework drawn up to guide test development and the interpretation of the results.

Student performance is reported on an overall scale for each domain, with subscale scores for the cognitive processes and main content areas reported for the main domain only. The overall scale for each domain was fixed to have an average of 500 and a standard deviation (SD) of 100 across OECD countries when it was the main domain for the first time (2000 for reading, 2003 for mathematics, and 2006 for science).

Proficiency levels are also reported. These levels describe what students are capable of doing at each level of achievement. Students performing below Level 2 are considered to be lower-achievers that do not demonstrate the baseline skills necessary for everyday life. Those performing at or above Level 5, on the other hand, are considered to be higher-achievers. More detail on the skills associated with each level in the three domains is available in Chapters 3, 4 and 5.

2.1 Performance in Previous PISA Cycles and Other Studies

2.1.1 PISA mathematics, 2003-2018

Since PISA was first implemented in 2000, mathematics has been the main assessment domain on three occasions; in 2003, 2012, and now in 2022. In the 2003 and 2012 cycles, the mathematics assessment was conducted on paper,[24] with 2022 being the first assessment with mathematics as the main domain where all items were completed on computer in Ireland. When the change was made to computer-based-testing in 2015, a subset of the paper-based items used in 2012 was transferred to a computer-based presentation. During this transfer, attention was paid to maintaining consistency of the items between the different modes. Testing in 2022 therefore, was the third cycle in which students completed the mathematics assessment on computer, and the first time they encountered mathematics items that were specifically designed with a digital delivery in mind.

[24] In 2012, an optional computer-based test of mathematics was offered, and Ireland participated in this option.

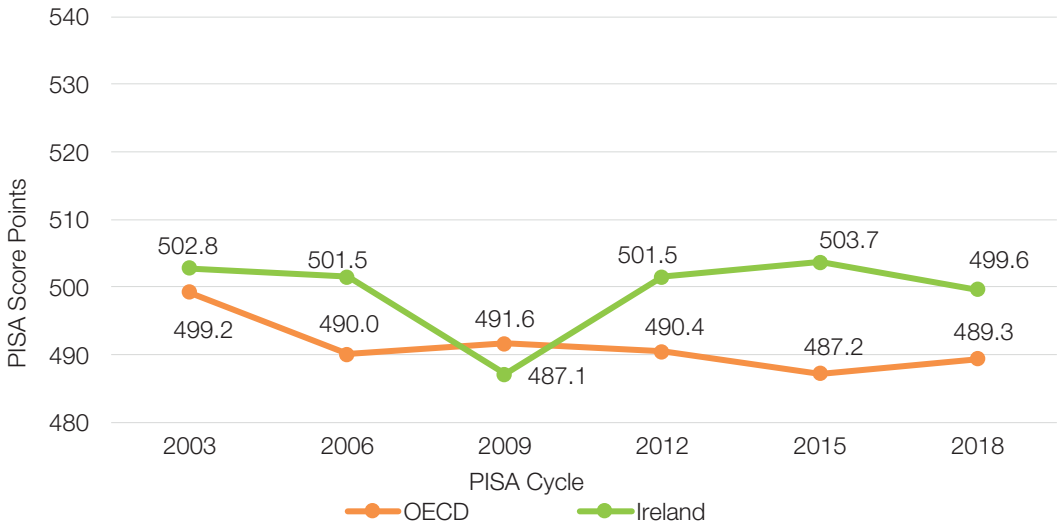
2.1.1.1 Mean scores

The overall trend for mathematics performance in Ireland over all cycles of PISA between 2003 and 2018, is one of relative stability, with the exception of 2009 when a significant decline was observed both in mathematics and reading.[25] The 2015 cycle was the point of highest achievement for students in mathematics in Ireland, with a mean score of 503.7. However, between 2015 and 2018, there was a non-significant decline of 4.1 points.

In 2003, when mathematics was first the main domain in PISA, students in Ireland achieved a mean score of 502.8 in mathematics. This was not significantly different from the OECD average at the time (500.0). In 2012, when mathematics was last the main domain, students in Ireland achieved a mean score of 501.5, which was significantly higher than the OECD average of 490.4. In that cycle, 16 countries/economies achieved significantly higher mean scores than Ireland while Ireland's performance did not differ significantly from that of nine other countries/economies. When a 95% confidence interval is applied, Ireland's true rank in 2012 ranged from 11th to 17th across the OECD countries, and 18th to 24th across all participating countries (Perkins et al., 2013).

Looking at the period between the 2012 and 2018 cycles, Ireland's mean score in mathematics increased slightly in 2015 to 503.7, before decreasing by about four points in 2018 to 499.6 (though this decrease was not statistically significant). In the same period, the OECD average score decreased significantly between 2012 and 2015 (from 490.4 to 487.2), but increased between 2015 and 2018 (to 489.3), although this increase was not statistically significant.

Figure 2.1. Performance on PISA mathematics 2003-2018, for the OECD and Ireland



Note. The OECD average for 2003 is based on 30 countries, for 2006 on 37 countries, for 2009 on 36 countries (excluding Austria), and for 2012-2018 on 37 countries again. Source: OECD, 2019b, Table I.B1.11.

2.1.1.2 Mathematics subscales

When a subject area is the main domain in PISA, scores are also broken down by a number of subscales. In mathematics, these fall into two categories: content subscales, and cognitive process subscales. Data on mathematics subscales are available for the 2003 and 2012 cycles.

[25] The decline in mean mathematics scores in Ireland between PISA 2009 and 2003 was the second largest of 39 countries (Cosgrove & Cartwright, 2014). Reading also showed large decreases, while performance in science remained stable.

In the 2003 and 2012 cycles, four content area subscales were reported on: shape & space, change & relationships, quantity, and uncertainty (known as uncertainty & data in 2012). In both cycles, students in Ireland performed best on the uncertainty (& data) subscale (517.2 in 2003 and 508.7 in 2012), and least well on space & shape (476.2 in 2003, and 477.8 in 2012). The performance of students in Ireland was significantly higher than the OECD average on the change & relationships (506.0 in 2003 and 501.1 in 2012), and uncertainty (& data) subscales, and significantly below the OECD average on the space & shape subscale in both cycles. A small increase in the performance of students in Ireland on the quantity subscale between 2003 (501.7), and 2012 (505.2) means that the average score for Ireland was not significantly different from the OECD average in 2003 but significantly above it in 2012 (Cosgrove et al., 2004; Perkins et al., 2013). Thus, the uncertainty (& data) and change & relationships content areas have been areas of relative strength for students in Ireland, while space & shape has consistently been an area of relative weakness.

In 2012, PISA reported on three mathematical cognitive process subscales. Students in Ireland in 2012 performed above the OECD average on two process subscales (interpreting and employing). They performed best on the interpreting subscale (with a mean score of 506.8), followed by the employing subscale (502.3). The performance of students in Ireland on the formulating subscale did not differ significantly from the OECD (492.4 in Ireland, compared with 491.6 at the OECD average).

2.1.1.3 Proficiency Levels

There have been changes in the proportions of mathematics higher- and lower-achievers in Ireland over the PISA cycles. The percentage of lower-achieving students (i.e. those scoring below Level 2) remained relatively stable between 2003 (16.8%) and 2018 (15.7%), with the exception of the 2009 cycles when 20.8% of students performed below baseline proficiency. Across the cycles since 2003, the proportions of students in Ireland performing below Level 2 was lower than on average across the OECD. Examining the other end of the achievement scale, the percentage of students performing at or above proficiency Level 5 in Ireland was 11.4% in 2003, and also remained relatively stable until 2015 (9.8%), except for 2009 when this percentage dropped significantly to 6.7%. The proportion of higher-achieving students in Ireland also decreased in 2018 to 8.2%, and while the percentage of higher-achieving students in 2018 did not differ significantly from the corresponding percentage in 2015, it was significantly lower than in 2012. In each cycle since 2003, the percentage of students in Ireland performing at Level 5 and above in mathematics has been lower than the average across OECD countries (OECD 2019b, Table I.B1.8).

2.1.1.4 Gender

Across all cycles of PISA in Ireland, males have consistently outperformed female students, and this has also been the trend at OECD level. Male students in Ireland achieved higher mean scores in mathematics compared to their female peers in the 2003 and 2012 cycles, outperforming them by 14.8 points in 2003, and 15.3 points in 2012. In 2012, across the OECD average, this gender difference was 10.6 score points. However, a narrowing of this gap can be seen in Ireland in the most recent cycle, 2018, where the difference of 5.9 points in favour of males is not statistically significant (McKeown et al., 2019).

2.1.2 PISA reading literacy, 2000-2018

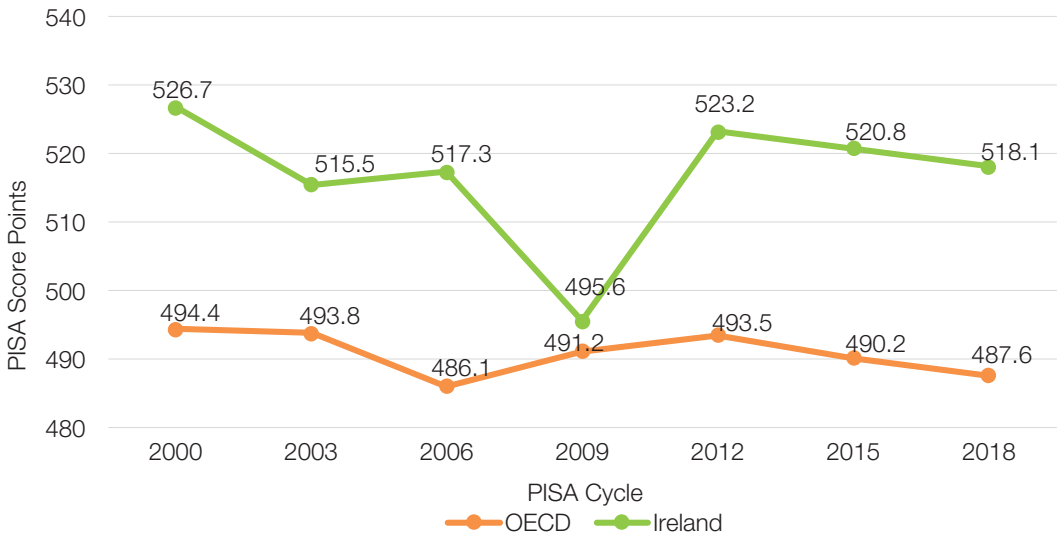
2.1.2.1 Mean scores

Reading was the main domain in the 2000, 2009, and 2018 PISA cycles. As previously mentioned, the transition to computer-based testing was made across all three domains in 2015, and Multi-Stage Adaptive Testing (MSAT) was introduced in reading for the first time in 2018.

Ireland achieved a mean score of 526.7 in 2000, when reading was first the main domain, and this decreased to 495.6 by the 2009 cycle, when it was the main domain for the second time. This decrease was also observed in mathematics achievement in Ireland in 2009, though science achievement remained stable in that cycle. These drops in both reading and mathematics proved in time to be outliers with respect to the general trends in both domains in Ireland.[26] After 2009, reading achievement increased to 523.2 in the following cycle in 2012. In 2015, Ireland's mean reading score declined by 2.4 points, and in 2018 it dropped by a further non-significant 2.7 points to 518.1. Neither of these declines were statistically significant.

Ireland's performance in reading has been significantly above the average OECD performance in every cycle but 2009 (where Ireland's performance was close to the OECD average). Between the 2009 and 2015 cycles, a small and non-significant decrease of one score point was noted at the OECD average. This decreased again in 2018 when a drop of 3.1 points brought the OECD average to 487.6.

Figure 2.2. Performance on PISA reading literacy 2000-2018, for the OECD and Ireland



Note. Data for OECD average in 2000 are based on 23 countries, 29 countries for 2003, 35 countries for 2006 (excluding Austria and the United States); data for 2009-2015 are based on the average of 35 countries (excluding Austria and Spain).
Source: McKeown et al., 2018.

2.1.2.2 Proficiency Levels

In Ireland, 17.2% of students performed below Level 2 in reading in 2009. This percentage decreased significantly in 2012 to 9.6%, before steadily rising again in 2015 to 10.2% and 11.8% in 2018. The drop in the percentage of students in this category between 2009 and 2018 of 5.4 percentage points

[26] See Cosgrove & Cartwright, 2014, and Cosgrove 2011 for more on factors that may have contributed to this sharp decline in PISA mean scores.

is statistically significant. At the OECD average, the proportions of students performing below Level 2 were larger than in Ireland in 2009 (19.4%), 2012 (18.8%), 2015 (20.8%), and 2018 (22.5%) (OECD 2023c, Table I.B1.5.2 and OECD 2019b, Table I.B1.10).

At the other end of the scale, 7.0% of students in Ireland performed at or above Level 5 in 2009. This increased to 11.4% in 2012, before dropping slightly in 2015 (10.7%), and increasing again in 2018 to 12.1%. There has been relative stability in this category when comparing 2012 and 2018, but the increase between 2009 and 2018 (an increase of 5.1%) is significant. In the same period, the percentage of students at or above Level 5 at the OECD average was similar to Ireland in 2009 (7.3%) but was significantly below Ireland in 2012, 2015 (8.0%, 8.1% respectively), and 2018 (8.7%) (OECD 2019b, Table I.B1.7).

2.1.2.3 Gender

Across the cycles of PISA, a large difference in reading performance in favour of female students has been observed in Ireland, and internationally. In PISA 2009, the mean score for female students in Ireland was 515.4, while that of male students was 476.3 (the difference of 39.2 points was statistically significant) (Perkins et al., 2010). In 2012, this gap reduced to 28.5 points, and narrowed further to 12.0 points in 2015, before widening again in 2018 to 23.2 points. The narrowing in 2015 coincided with the introduction of computer-based testing. At the OECD average, the gender gap in reading performance was 39.3 points in favour of female students in 2009, narrowing to 27.3 points in 2015, before widening slightly again to 29.7 in 2018 (OECD 2019c, Tables II.B1.7.1, II.B1.7.27, II.B1.7.28, II.B1.7.29, II.B1.7.30).

2.1.3 PISA science, 2006-2018

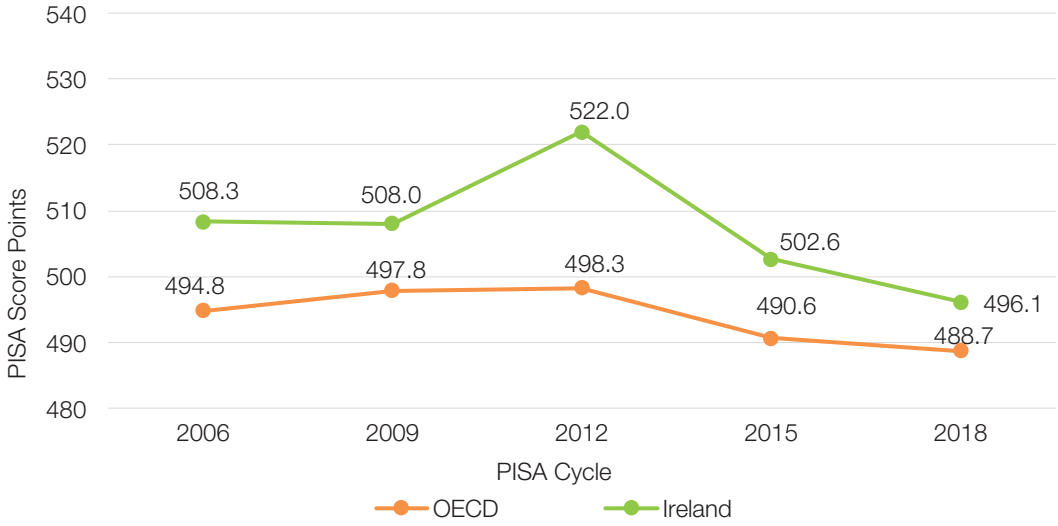
2.1.3.1 Mean scores

Science was the main domain for the first time in 2006, and was most recently the main domain in 2015. As happens when a domain is the major domain, new science assessment items were developed and a new science framework was drawn up for both cycles. The 2015 cycle was notable in the history of the PISA assessment, as it was the first time most countries implemented the assessment on a computer-based platform, using interactive simulation items for science.

Students in Ireland achieved a mean score in science of 508.3 in the 2006 cycle, and remained about the same in 2009 with a mean score of 508.0, before increasing significantly in 2012 to a mean of 522.0 (see Figure 2.3). Achievement then fell significantly in 2015 to 502.6, and again by a non-significant 6.5 score points to 496.1 in 2018 (OECD 2023c, Table I.B1.5.6 and OECD 2019b, Table I.B1.12). It should be noted that science performance remained stable in 2009 (compared to 2006), when performance in the other two domains decreased significantly, before increasing in 2012. This suggests that Ireland's science performance may have been potentially higher in 2009 but could have been pulled back by some of the factors that contributed to the declines in reading and mathematics (Shiel et al., 2016). In addition, it is noteworthy that the decrease observed in 2015 coincided with the introduction of computer-based testing in most PISA countries (Shiel et al., 2016).

The OECD average science achievement dropped from 494.8 in 2006 to 490.6 in 2015 though the difference is not statistically significant. The OECD average was 2.0 score points lower in 2018 than in the previous cycle, though again, this difference was not significant.

Figure 2.3. Performance on PISA science 2006-2018, for the OECD and Ireland



Source: Data for 2006, 2012, 2015, 2018 is the OECD average of 37 countries, and for 2009 the average of 36 countries (excluding Austria). Source: OECD, 2019b, Table I.B1.12.

2.1.3.2 Proficiency levels

With the exception of the 2012 cycle, there has also been a pattern of relative stability in the proportions of students performing below Level 2 in science in Ireland across PISA cycles. In 2006, students in this category accounted for 15.5%, while that figure in 2015 was 15.3% before increasing in 2018 to 17.0%. It should be noted that there was a decrease in this lower-achieving category in 2012, when just 11.1% of students performed below Level 2. On average, at the OECD level, the percentages of students performing below Level 2 have seen little change, with a figure of 20.9% in 2006, increasingly slightly to 22.1% in 2015, and decreasingly marginally to 22.0% in 2018 (OECD 2019b, Table I.B1.9).

The percentages of higher-achievers (those performing at Levels 5 and 6) in Ireland decreased from 9.4% in 2006 to 7.1% in 2015, and a further slight decline was witnessed in 2018 when the figure decreased to 5.8%. The difference between 2015 and 2018 levels is not statistically significant however, the percentage of students performing at or above Level 5 in 2018 is significantly lower than in 2012 (OECD 2019b, Table I.B1.9).

2.1.3.3 Gender

The pattern of gender differences in science has changed in Ireland over PISA cycles. In 2006, no difference in performance between male and female students was recorded (Eivers et al., 2007). In 2015, when testing changed to computer-based mode of assessment, male students outperformed female students in Ireland by a significant 10.5 score points. In 2018, there was a non-significant difference of 1.5 points in favour of female students in Ireland. At the OECD level, on average in 2006 males outperformed female students by a significant 2.2 score points. This gap increased to a significant 3.2 score points in favour of male students in 2015, before changing to a significant 2.4 gap in favour of female students in 2018 (OECD 2019c, Tables II.B1.7.5, II.B1.7.37, II.B1.7.38, II.B1.7.39).

2.1.4 TIMSS 2019

The Trends in International Maths and Science Study (TIMSS) is a study coordinated by the International Association for the Evaluation of Educational Achievement (IEA), and measures the mathematics and science achievement of Grade 4 (Fourth Class) and Grade 8 (Second Year) students internationally on a four-year cycle. This contrasts with PISA which uses an age-based sample on a three-year cycle. Additional points of difference with PISA are that mathematics and science are given equal weighting in TIMSS as opposed to there being main and minor domains, and that the TIMSS assessments are curriculum-based rather than focusing on real world skills. Ireland has participated in four cycles of TIMSS in Second Year: in 1995, 2015, 2019 and 2023. Results for TIMSS 2023 will be published at the end of 2024, so 2019 is the most recent TIMSS cycle for which there are data currently available.

Second Year students in Ireland achieved a mean overall mathematics score of 524 in TIMSS 2019. Six countries achieved a score that was significantly higher than Ireland's. These were Singapore, Chinese Taipei, Korea, Japan, Hong Kong and the Russian Federation. The performance of a further six countries (Lithuania, Israel, Australia, Hungary, United States and England) was not significantly different to Ireland in 2019.

The overall achievement score in science for students in Ireland in 2019 was 523.There were seven countries whose average performance was significantly better than Ireland's, and these were Singapore, Chinese Taipei, Japan, Korea, the Russian Federation, Finland, and Lithuania. In the same cycle, eight other countries (Hungary, Australia, United States, Sweden, Portugal, England, Turkey and Israel) achieved an overall mean score in science that was not significantly different to Ireland's.

Between the previous cycle of TIMSS in 2015 and 2019, Ireland's overall mean achievement score for science declined by seven points, although this change was not statistically significant, while Ireland's mean mathematics performance remained stable with a difference of less than one point between the two cycles (Perkins & Clerkin, 2020).

2.1.5 PIRLS and NAMER

The Progress in International Reading Literacy Study (PIRLS) is an international study of reading literacy at Grade 4 (Fourth Class) that is also implemented by the IEA on a five-year cycle. In 2021, Ireland participated in PIRLS for the third consecutive time, and was one of 57 countries that took part.

Like many other studies around this time, PIRLS 2021 was substantially affected by the COVID-19 pandemic. A plan to transition to digital assessment in Ireland was postponed, and as a result, the assessment was again paper-based in 2021. Additionally, due to on-going school closures in spring 2021 in Ireland, it was decided to implement the study in autumn when the sampled pupils were at the beginning of Fifth Class, rather than at the end of Fourth Class, as in previous cycles. This change means that caution is needed when making comparisons between the results in previous iterations of PIRLS in Ireland, but also when comparing PIRLS 2021 reading achievement in Ireland with other countries that tested at the end of Grade 4 (see Delaney et al., 2023, for more detail on the caveats associated with interpreting these results).

Pupils in Ireland achieved a mean reading score of 577, which was significantly higher than all countries which implemented PIRLS 2021 at the start of Grade 5 (Fifth Class), and most countries where PIRLS 2021 took place at the end of Grade 4 (Fourth Class). Singapore achieved a mean score of 587, which was significantly higher than Ireland, and Hong Kong achieved a mean score of 573,

which was not significantly different to Ireland's score. It is likely that Ireland's performance would have been somewhat lower had testing taken place at the end of Fourth Class (Delaney et al., 2023).

The National Assessment of Mathematics and English Reading (NAMER) assesses the mathematics and reading skills of Second Class and Sixth Class pupils in Ireland. The most recent cycle of NAMER took place in 2021, having been postponed for one year due to school closures following the outbreak of the COVID-19 pandemic. To take account of the challenges facing schools during the pandemic changes were made to the administration of NAMER in 2021. Pupils in Second Class were tested in reading only, and pupils in Sixth Class were tested in mathematics only, whereas in previous cycles pupils at both grades were assessed in both subjects. Testing took place in the aftermath of a second extended period of pandemic-related school closures, following similar closures in 2020.

Overall performance on reading in Second Class and mathematics in Sixth Class was broadly similar to the previous cycle of NAMER in 2014. Performance was slightly lower for both, moving from 264.0 to 260.8 in Second Class reading, and down from 261.7 to 260.5 in Sixth Class mathematics,[27] but the differences were not statistically significant. Similarly, the percentages of pupils performing at the different proficiency levels in both tests was not significantly different than in 2014 (Kiniry et al., 2023).

2.2 Recent Developments in Education Relevant to PISA in Ireland

This section looks at the policy context of PISA in Ireland, and describes some policies that might be expected to have some impact on performance in PISA.

2.2.1 Strategies and policies relevant to PISA

The Department of Education's *Action Plan for Education 2016-2019* (DES, 2016) mentions improvement in PISA performance as a key element in achieving goal 1 (improving the learning experience and success of learners). This policy document recognises recent improvements in PISA performance in reading, mathematics and science, but states that further improvements are required, particularly in the domains of mathematics and science. In response to this objective, three clear PISA targets to be reached by 2025 are outlined. The first target was for an increase in the proportions of students at or above proficiency Level 5. The second target was for a consolidation (in reading), or decrease (in mathematics and science) in the proportions of learners below Level 2. The last target was for a consolidation of Ireland's top ten position among OECD countries in reading and science, and an aim to reach this position for mathematics.

Another set of targets are included in the *National Strategy for Literacy and Numeracy* (DES, 2011; 2017b). This strategy was introduced due to concerns around national educational standards in the fundamental skill-areas of literacy and numeracy. These concerns were prompted in part by Ireland's performance in PISA 2009, when the mean scores in reading and mathematics dropped significantly. The strategy was reviewed and updated in 2016, when new targets and priorities were set for the period 2017-2020 (DES, 2017). Separate targets were set for PISA achievement in all post-primary schools, and DEIS post-primary schools. Table 2.1 sets out the targets for all post-primary schools.

[27] NAMER mean scores were set to a centre-point of 250 points, and a standard deviation of 50 points, unlike TIMSS and PIRLS, which are centred around a mean score of 500 with a standard deviation of 100.

Table 2.1. Targets in the Action Plan for Education 2016-19 and revised Strategy for Literacy and Numeracy targets (2017-2020)

	PISA Proficiency Levels*	Action Plan 2016-2019 *(by 2025)*	Literacy Numeracy Strategy 2017-2020	Position as of PISA 2015	Position as of PISA 2018
Reading literacy	Below Level 2	Less than 10%	Below 8.5%	10.2%	11.8%
	At or above level 5	13%	12%	10.7%	12.1%
	At or above level 4	-	40%	37.1%	36.2%
Mathematics	Below level 2	Less than 10%	10.5%	15.0%	15.7%
	At or above level 5	Above OECD avg (2015: 10.7%, 2018: 10.9%)	13%	9.8%	8.2%
	At or above level 4	-	36%	31.0%	29.1%
Science	Below level 2	Less than 10%	-	15.3%	17.0%
	At or above level 5	13%	-	7.1%	5.8%
	At or above level 4	-	-	27.1%	24.8%

* For 'Below Level 2', a lower percentage of students is preferable, while for Levels 5-6, a higher one is preferable.

In the 2018 PISA cycle, the results for which were released after the publication of the Action Plan, Ireland did indeed reach the Action Plan target of being among the top ten OECD countries in reading, but this target was not met for science or mathematics. The target outlined in the revised Strategy for National Literacy and Numeracy of 12% of students performing at or above Level 5 in reading was met in PISA 2018. However, all other targets in both the Action Plan and the National Strategy for Literacy and Numeracy around proficiency levels were not met in 2018, and as a general trend, the results from both 2015 and 2018 placed Ireland slightly further away from the stated objectives. The Action Plan targets were set to 2025, presumably to coincide with the release of the results from the planned 2024 PISA Main Study. However, due to the delay in the PISA 2022 Main Study (outlined in Chapter 1), the next PISA Main Study will not take place until 2025, and the results will not be available until later in 2025, meaning the success or otherwise of meeting these targets will not be assessed until after that date. See the concluding chapter of this report for a discussion around these targets.

2.2.2 Digital Strategy and Digital Learning Framework

As teaching, learning and assessment gradually draw in more digital elements, both in Ireland and internationally, a number of strategies have sought to support the transition to digital learning in the Irish educational system. The integration and embedding of digital technologies into education provides additional opportunities for diverse learning approaches, differentiated teaching and learning, and increased engagement with the subject matter.

The *Digital Strategy for Schools to 2027* followed on from the previous strategy that covered years 2015-2020, and draws on the EU *Digital Education Action Plan* (2021-2027). The new strategy noted how over the lifetime of the previous strategy the use of digital technologies became more commonplace in teaching, learning, and assessment in Ireland. Published during a period of

disruption to education caused by the COVID-19 pandemic, it commented on how the extensive use of digital technologies in education during school closures and pandemic restrictions helped schools to ensure continuity of teaching and learning during this time. The objective of the new strategy is to support the Irish school system in developing learning experiences that encompass the development of digital competences for all learners, independent of their socio-economic circumstances, learning needs, or location. The strategy outlines three pillars that underpin it; firstly, supporting the embedding of digital technologies into teaching, learning, and assessment; secondly, investment in and development of digital technology infrastructure; and finally, a focus on the future with an emphasis on further development in the areas of policy, research and digital leadership.

A key element in the implementation of the digital strategies in an Irish educational context to date has been the *Digital Learning Framework (DLF)*. This framework drew on and adapted international frameworks like the UNESCO ICT Competency Framework (UNESCO, 2018) to the Irish educational context.

The implementation of the DLF in the Irish educational context has been evaluated in a longitudinal study, conducted by the ERC. A baseline evaluation (Cosgrove et al., 2018) preceded a follow-up evaluation published in 2021 (Feerick et al., 2021). The final planned evaluation (Wave 2) was delayed due to the impact of COVID-19, and is due to be published in 2024. The Wave 1 report found evidence of high levels of teacher engagement with digital technologies (DTs), participation in Continuing Professional Development related to digital technologies, and positive attitudes to DT usage. There were also indications that schools were planning for DLF embedding, showing high levels of embedding DTs into teaching, learning and assessment, and had regular access to school-owned devices. Interestingly, in the context of PISA, DLF had higher levels of perceived positive impact at post-primary level compared to primary level. However, post-primary teachers had a more restricted view of the way DTs can be used in educational settings, compared to primary teachers (Feerick et al., 2022). In the Wave 1 findings, consistent with the baseline findings, perceived levels of infrastructure, connectivity and technical support were in the moderate range, with a lot of variation between schools on this measure. In addition, the area of DT use in formative and summative assessment was judged to be in need of further development.

These findings are of particular relevance to PISA, given the increasing emphasis on item-types that seek to exploit the features and elements offered by computer-based testing. There is evidence to suggest that students and teachers alike have become more acclimatised to using DTs in teaching, learning and assessment due to shifts imposed by the COVID-19 pandemic, and the publication of the final DLF evaluation report in 2024 will provide further opportunity to examine this.

2.2.3 The STEM Educational Policy Statement and Implementation Plan

The *STEM Education Policy Statement 2017-2026*, and the *STEM Education Implementation Plan 2017-2019* seek to transform the experiences of learners in relation to STEM subjects. While recent improvements in STEM education in Ireland are acknowledged, the STEM Education Policy Statement and Implementation Plan aim to address some challenges that still remain. In particular, these include ensuring significant improvements in students' in Ireland problem-solving, inquiry-based learning and team working skills; increasing the number of students choosing STEM subjects and pathways at post-primary level and beyond; increasing participation of females in STEM education and careers; raising interest in and awareness of STEM careers; and sustaining the involvement of young people in STEM education.

Covering educational contexts from early years to post-primary, the policy aims to promote engagement in STEM, through four pillars: nurturing learner engagement and participation; enhancing early years educator and teacher skills; supporting STEM education practice; and using evidence to support STEM education. International studies like PISA and TIMSS are highlighted under pillar three, as providing benchmarks for achievement to support the evaluation of STEM education at post-primary level.

2.2.4 Junior and Senior Cycle reform and curricular developments

2.2.4.1 Framework for the Junior Cycle

The Junior Cycle of post-primary education in Ireland covers Grade 7 to Grade 9 (or First Year to Third Year as they are referred to in the Irish system). The current Framework for Junior Cycle was published in 2015. It seeks to underline how teaching, learning and assessment practices develop for 'the delivery of a quality, inclusive and relevant education' (DES, 2015, p.6). The framework aims to deliver flexibility in learning programmes, and ensure there is balance between the acquisition of knowledge and skills, as well as a wider approach to assessment. The framework is built around eight principles, twenty-four outcome-related statements of learning, and eight key skills. The principles, covering areas such as flexibility, creativity, engagement and wellbeing, should be used by schools to guide the development of junior cycle programmes.

The key skills are outlined in Figure 2.4 below. These skills were identified as necessary for learning in the context of the junior cycle curriculum, but also in the outside world. Students' proficiency in these skills is to be strengthened throughout the cycle. The specifications for each subject outline learning outcomes to help develop each of these skills in the context of that subject and achieve specified learning outcomes. Under the framework, schools have greater autonomy to implement a programme of subjects, short courses and other learning experiences that suits the needs of its students and the school context, using the core principles, statements and key skills of the framework.

Figure 2.4: The Key Skills of the Junior Cycle

Source: Adapted from DES, 2015.

New curriculum and assessment specifications were phased in over a number of years, with the final group of new subject specifications introduced in 2019, and reported under the Junior Cycle Profile of Achievement (JCPA) in 2022 (Kirk, 2019). The timeline for the introduction of new subject specifications and JCPA reporting for PISA subjects is outlined in Table 2.2.

Table 2.2 Schedule of new Junior Cycle introduction dates relevant to PISA, for First Year students, and for the first JCPA

Subject	First introduced to First Year students	Expected first year of JCPA reporting
English	September 2014	Autumn 2017
Science	September 2016	Autumn 2019
Mathematics	September 2018	Autumn 2021[28]

The specification for each subject outlines the aim and rationale, how it links to the statements of learning and key skills of the framework, what the various strands and learning outcomes of the subject are, what the expectations of students are, and how the subject will be assessed. Subject specifications outline three to four contextual strands of that subject, while maths and science each have an additional unifying strand. Within the various strands a number of learning outcomes are specified, and these are grouped into a number of elements that are common across the strands.

The approach to assessment was one of the biggest changes in the framework, with a greater emphasis on formative assessment than previously, complementing summative assessment at the end of the junior cycle. The specifications recognise the importance of assessment to support learning, and outline different modes of assessment, including focused feedback to allow students to become more responsive, active learners.

[28] The JCPA was not used for reporting in 2020 and 2021 due to the COVID-19 pandemic.

In practice what this means is that students would complete two classroom based assessments at defined points in the cycle, which are assessed by their teacher. Another element of the formative assessment is an assessment task, which is graded by the State Examinations Commission (SEC), as is the Final Assessment, a two-hour written examination. This leads to the award of the Junior Cycle Profile of Achievement to students at the end of the cycle. However, changes to assessment within the Junior Cycle were necessitated by the outbreak of the COVID-19 pandemic. Due to significant school closures in those school years and on-going challenges facing students and schools in the midst of the pandemic, all standardised Junior Cycle assessments were cancelled in 2020 and 2021, meaning the JCPA was not awarded to students. Students instead completed the cycle with a State Certificate of completion and a school report of their achievement in the Junior Cycle based on assessment determined by the school. This affected Fifth and Sixth Year students who took part in PISA 2022 in Ireland (16.2% and 0.5% of the sample respectively, see Table 1.3. in Chapter 1). The JCPA was again awarded to students in 2022 and 2023, albeit with changes to the originally envisaged assessment arrangements, with students required to complete one of the two classroom based assessments, and not required to complete the assessment task.

The vast majority of students who took part in PISA 2022 in Ireland have been taught the relevant subjects under the most recent specifications, with the exception of the small group of 25 Sixth Year students who made up 0.5% (weighted) of the sample (see Table 1.3. in Chapter 1). These students would have completed mathematics in the Junior Cycle under the previous syllabus.

A report by the Department of Education Inspectorate found the overall quality of teaching and learning to be good or very good, and that the development of the Junior Cycle key skills was facilitated to some extent in almost all lessons. This report recommended that schools make regular use of, and promote a culture of formative assessment (DoE, 2023b). Mc Garr et al. (2023), in their longitudinal study exploring the implementation of the Framework for Junior Cycle, found evidence that teachers reported giving a greater volume and more formative feedback to students, and were making greater use of project-based learning via classroom-based assessments, but noted that the final examinations are still a central concern.

Part of the rationale outlined in the English specification is recognising the significance of language acquisition to social and personal development and ensuring students are assured and skilled in facing the challenges of education, work and life (NCCA, 2018).

The three main strands of the curriculum are oral language, reading and writing, and each of these strands is made up of three components: of communicating as a listener, speaker, reader and writer; exploring and using language; and understanding the content and structure of language.

The subject specification for science is placed in the context of building on what was learned in primary school and preparing students for the senior cycle, as well as facilitating them to contribute to life outside of education, and part of this is the development and enhancement of skills such as problem-solving, reasoning and decision-making (NCCA, 2015). Students should not just be able to explain phenomena, but also understand the process of scientific inquiry and examine evidence and make conclusions to become scientifically literate. A collaborative approach is emphasised, as is developing students' confidence to apply what they have learned in the real world.

The specification outlines four contextual strands of science, the physical world, the chemical world, the biological world, and Earth and Space, along with one unifying strand, the nature of science. This strand has ten learning outcomes across its elements: understanding, investigating, communicating and science in society. The specification sets out that teaching and learning should include some student-led inquiry with the purpose of achieving the outcomes of the unifying strand.

The mathematics specification is based on the idea of 'mathematics as an interconnected body of ideas and reasoning processes' and seeks to build on what students have learned in primary education and prepare them for the senior cycle outlining the progression across these stages (NCCA, 2018). It seeks to not just enhance and develop capabilities within the subject itself, but also to help students understand how aspects of mathematics such as understanding error, interpreting data and understanding timelines relate to subjects beyond mathematics. Proficiency in mathematics is articulated as having five connected components: understanding concepts, fluency in procedures, strategic competence, adaptive reasoning and productive disposition.

As with the science specification, the mathematics specification has four contextual strands (number; geometry and trigonometry; algebra and functions; and statistics and probability), as well as a unifying strand, that covers elements such as building blocks, representation, connections, problem-solving, generalisation and proof, and communication.

The previous syllabus for mathematics, introduced through the Project Maths initiative, was phased in between 2008 and 2015. A review of the impact of this syllabus indicated that while the introduction of the programme appeared to have had a small positive impact on overall achievement in mathematics in Ireland as measured by international assessments, and influenced approaches to teaching and learning, significant weaknesses in the areas of space and shape (in PISA) and algebra and geometry (in TIMSS) have persisted (Shiel & Kelleher, 2017).

2.2.4.2 Changes to the Senior Cycle

With the change to autumn testing in the PISA 2022 Main Study, 57% of the student cohort were in Transition Year (Grade 10), while 16.2% of students were in Fifth Year (Grade 11). Students in Fifth Year may have had up to three months' instruction in the Senior Cycle by the time they were assessed as part of PISA (see Table 1.3 in Chapter 1 for more detail on the distribution of students by grade in PISA 2022).

In 2022, the National Council for Curriculum and Assessment (NCCA) completed a four-year review of the senior cycle. The review recommended the introduction of a more flexible, dynamic curriculum and a wider range of assessment as part of a three-stage redevelopment of the cycle encompassing curricula review, development of senior cycle pathways and ensuring coherence across all aspects of the cycle (NCCA, 2022). The Minister for Education announced a redevelopment programme for senior cycle in March 2022, which included updated specifications for a number of subjects including Business Studies, Arabic, Classical Languages, Biology, Physics, and Chemistry, and the launch of two new subjects, Drama, Film and Theatre Studies, and Climate Action and Sustainable Development. Subject Development Groups have been convened to draw up the subject specifications for the first group of subjects, which are due to be launched in 2025. The new specifications will include new external assessments, separate from the State Examinations, but also under the auspices of the State Examinations Commission (DoE, 2023a). The development of the new programme follows the *Senior Cycle Review: Advisory Report* (NCCA, 2022).

2.2.5 Teaching and learning during COVID-19

Since the last PISA cycle in 2018, school systems across the world have experienced significant periods of disruption due to the COVID-19 pandemic. While research in this area is understandably in its infancy given the proximity to the pandemic, some studies have sought to describe the impacts of school closures, the switch to remote learning, and other public-health measures on learning in Ireland. The Economic and Social Research Institute (ESRI) produced two reports early in the

pandemic, the first of these, *Implications of the COVID-19 Pandemic for Policy in Relation to Children and Young People: A Research Review (2020),* drew on Growing Up in Ireland data along with that from other studies to document the lives of children and young people pre-covid, and contrast the findings with indications from emerging national and international studies on the impact of COVID-19 on this cohort. One of the areas of interest in the report was education. The study found that there was evidence that the move to remote learning may have had the greatest impact on students belonging to disadvantaged families, families with children with special educational needs, and migrants (Darmody et al., 2020, p.40), and called for policy interventions to address the exacerbation of existing inequalities caused by school closures.

Another ESRI report was entitled *Learning for All? Second-Level education in Ireland during COVID-19* (Mohan et al., 2020). It documented the changes to schooling observed in Ireland at post-primary level during the initial school closures in spring 2020, including the switch to remote learning, and the cancellation of Leaving Certificate and Junior Cycle in-person examinations. Schools reported challenges in the switch to remote learning, noting there was little time to prepare for such a sea change in the mode of instruction, and commenting how planning in the midst of such uncertainty was difficult. A digital divide between schools, relating to access to high-speed broadband and adequate provision of devices was noted, and was observed as being more pronounced in DEIS schools. Motivation was also found to be a challenge for students, and problems with motivation were reported to be exacerbated by poor infrastructure. Again, this was seen to be more of a challenge in DEIS schools. Ultimately, like the previous report, the findings gave rise to concerns that pre-existing disparities experienced by students from disadvantaged backgrounds, and students with special educational needs were intensified by the move to remote learning. In general, student well-being was noted as being a particular challenge in the context of remote learning when the school building – the locus of the school community – was closed. Earlier in this chapter, encouraging results at primary level in the PIRLS and NAMER studies were described, showing relative stability in achievement despite the challenges posed by pandemic. These studies seemed to go some way towards addressing concerns about learning during the pandemic.

During the academic years 2019-20, and 2020-21, when schools in Ireland experienced closures related to the COVID-19 pandemic, the Department of Education issued advice and guidelines to schools to help them transition to remote teaching and learning through circulars and policy documents. A report published by the Inspectorate in June 2021 (DoE, 2021), drew on a series of online questionnaires, telephone surveys and focus groups with principals, parents, and students to investigate the provision of online teaching during school closures, communications between schools and students/parents, support for learners, students' experiences of learning from home, and their well-being during this time. The report found evidence of appropriate planning in schools for remote teaching, improved capacity for remote learning, and improved communications between school and home when compared to spring 2020. Generally, parents reported high levels of satisfaction with support provided for learners, and engagement by teachers with students during remote learning, but some parents of students attending special schools were less content. Many students reported spending less time on learning than when attending in-person, finding the experience of learning from home more challenging than when attending in person, and exercising less when at home. Some of these themes will be discussed in relation to the Global Crises Module questions from the PISA 2022 Student Questionnaire in Chapter 6.

2.3 Summary

PISA 2022 was implemented during a time of unprecedented change and disruption for education systems worldwide. School closures and other restrictions associated with the COVID-19 pandemic challenged education systems in all the countries participating in PISA 2022, requiring teachers and students to adapt to remote learning, and to adopt digital technologies to maintain continuity of teaching and learning.

This chapter looked back at Ireland's performance in PISA since its inception in 2000 to 2018, when reading was the main domain. Since 2012, performance on mathematics in Ireland has been above the OECD average. Performance in science reached a high-point in the 2012 cycle, but was otherwise relatively consistent across cycles (2006, 2009, 2015 and 2018), although a non-significant decline of 6.5 points was observed in 2018. Again, in science, students in Ireland have performed above the OECD average in each cycle since 2006, when science was first assessed as the major domain. Finally, performance in reading has also been consistently above the OECD average across all cycles since 2000, with the exception of the 2009, when Ireland's score and the OECD average did not differ significantly from each other.

Students in Ireland have relatively strong performance on the change & relationships, and uncertainty (&data) mathematics content subscales in the 2003 and 2012 cycles of PISA. In both cycles, the space & shape content area emerged as an area of relative weakness, with students in Ireland performing significantly below the OECD average. In 2012, data were also available on the mathematics cognitive process subscales. Students in Ireland had above average performance on the interpreting and employing subscales, while performance on the formulating subscale did not differ significantly from the OECD average.

The pattern that emerges in relation to lower- and higher-achievers in Ireland over PISA cycles is that in general, relatively small proportions of students in Ireland have performed below proficiency Level 2 (lower-achievers) when compared with the OECD average, meaning that more students in Ireland perform above this baseline of competency when compared internationally. In contrast, Ireland shows lower levels of students at the higher end of the scale, showing either similar levels or lower levels than the OECD average, suggesting a relative under-performance of higher-achieving students in Ireland. Improvements in the levels of lower-achieving students in mathematics were noted in Ireland between 2012 and 2018 (decreasing from 16.9% to 15.7%), while declines in the proportions of students at or above Level 5 are evident.

Gender differences vary by domain in PISA internationally and nationally. In Ireland, male students have outperformed females in mathematics consistently across all cycles, though a narrowing of this gap is evident in 2018 and the difference was not statistically significant. In science, there is a more mixed picture, with no significant gender difference recorded in Ireland between the 2006 and 2012 cycles, then a shift in the 2015 cycle when males outperformed female students by a significant 10.5 points and this was followed by a non-significant difference in 2018. In reading, the balance has traditionally been in favour of female students, where they have significantly outperformed male students in each cycle. This gap narrowed in 2015, coinciding with the introduction of computer-based testing, before widening again in 2018, when female students had an advantage of 23.2 PISA score points compared to male students.

Ireland's overall mean achievement score in TIMSS 2019 for both mathematics and science did not change significantly since 2015, although performance in science dropped by a non-significant

seven points (Perkins & Clerkin, 2020). In mathematics, six countries achieved overall scores that were significantly higher than Ireland's, and a further six countries achieved mean scores that were not significantly different to Ireland's, with the remaining countries achieving mean scores that were significantly lower than Ireland's. In the same cycle in science, seven countries performed significantly better than Ireland, and eight other countries achieved overall mean scores in science that were not significantly different to Ireland's.

Pupils in Ireland achieved a mean reading achievement score in PIRLS 2021, which was significantly higher than all countries which implemented PIRLS 2021 at the start of Grade 5 (Fifth Class in Ireland), and most countries that where PIRLS 2021 took place at the end of Grade 4 (Fourth Class). Singapore achieved a mean score, which was significantly higher than Ireland's, and Hong Kong achieved a mean score, which was not significantly different to Ireland's. It is likely that Ireland's performance would have been somewhat lower had testing taken place at the end of Fourth Class (Delaney et al., 2023).

Overall performance on reading at Second Class and mathematics at Sixth Class in the most recent cycle of the NAMER in 2021 was broadly similar to the previous cycle of NAMER in 2014. Performance was slightly lower for both, but the differences were not statistically significant. Similarly, the percentages of pupils performing at the different proficiency levels in both tests were not significantly different than in 2014 (Kiniry et al., 2023).

During the period of implementation of the PISA 2022 cycle, a number of relevant policy interventions took place. Chief among these are the Department of Education's *Statement of Strategy 2019-2021*, the *Action Plans for Education (2016-2019 and 2019)*, as well as the National Strategy for Literacy and Numeracy (first published in 2011, and revised in 2017). Both the *Action Plan for Education (2016-2019)*, and the *Interim Review of the National Strategy for Literacy and Numeracy* set specific targets that reference performance in PISA. These targets outline areas for improvement, including objectives around Ireland's ranking among OECD countries, and percentages of students in the higher and lower proficiency level categories. While the target for the highest achieving students in reading was met in the most recent cycle of PISA, the other targets have not yet been met. A more detailed discussion of these targets in relation to the PISA 2022 results, can be found in Chapter 7.

The new Digital Strategy and the implementation of the Digital Learning Framework have particular relevance for PISA outcomes, especially since the switch to computer-based testing, and the introduction of new interactive item-types since 2015. Improvements to students' digital familiarity, experience with subject-specific digital content, as well as their digital literacy may prove to be influential in their performance on new items designed for delivery within a digital environment.

The Framework for the Junior Cycle was launched in 2015, with new subject specifications introduced on a phased basis up to 2019. As well as affording schools flexibility and autonomy in implementing learning programmes, the framework looks to strike a balance between acquiring knowledge and acquiring skills. Eight key skills that cut across all subjects are outlined in the framework, and these skills are fundamental to learning in the context of the junior cycle and in the outside world.

Specifications for each subject outline the aim and rationale of the subject and link it to the key skills and various outcome-related statements of learning outlined in the framework. Subjects are structured around a number of strands, with an additional unifying strand for some subjects such as mathematics and science, and a number of learning outcomes across each strand in addition to a unifying strand for some subjects.

Significantly, the framework introduced a wider approach to assessment, with increased formative assessment complimenting a revised summative assessment at the end of the cycle. The subject

specifications outline the mode of assessment for each subject, which include classroom-based assessments graded by class teachers, as well as an assessment task and a final examination, both marked by the State Examinations Commission (SEC). The vast majority of PISA 2022 students in Ireland (99.5%) participated in the junior cycle fully under the new framework and new subject specifications.

Following a recent review of the senior cycle by the NCCA, that recommended a more flexible, dynamic curriculum and a wider range of assessment, a revised senior cycle was announced in March 2022, the first phase of which will be launched in 2025. As well as the introduction of two new subjects, existing subjects will receive revised, coherent subject specifications which will outline a wider range of assessment.

Since the last cycle of PISA in 2018, the most notable development has been the disruption to educational systems caused by the COVID-19 pandemic. Some initial research on this topic has been carried out by the ESRI and the DoE Inspectorate. Reports by the ESRI indicated that there was some evidence that students who were experiencing disadvantage before the pandemic, were likely to experience an exacerbation of that disadvantage during school closures (Darmody et al., 2020 and Mohan et al., 2020). The second ESRI report highlighted the challenges facing students during remote learning caused by a digital divide. The knock-on effect of the digital divide was a fall in the levels in engagement and motivation in the students effected. These challenges for students during remote learning were again emphasised in the DoE Inspectorate report on remote learning in January and February 2021, where students reported spending less time learning remotely than when learning in-person, feeling less motivated to learn, and exercising less (DoE 2021). These themes will be further explored using data from PISA 2022 in Chapter 6.

Chapter 3: Performance on Mathematics

Key Findings

- **The overall mean mathematics score of students in Ireland in 2022 is 491.6. This is significantly higher than the OECD average score of 472.4.**
- **Nine countries/economies had mean mathematics scores significantly higher than Ireland's, while eight had scores that were not significantly different to Ireland's.**
- **Ireland's standard deviation for mathematics (79.6) is smaller than the OECD average (90.1) and relatively small compared to most other countries scoring above the OECD average. This indicates a narrower spread of mathematics achievement in Ireland compared to other countries.**
- **In Ireland, male students achieved a mean score of 497.8. This is higher than the mean score of female students (485.1). The difference (12.7 score points) is statistically significant.**
- **The mean mathematics score of students in Ireland in 2022 is significantly lower than in 2018 (499.6), and 2012 (501.5).**

This chapter is organised into six sections:

- A description of the framework underpinning PISA mathematics 2022;
- A description of performance in mathematics with reference to mean scores, in Ireland and in other participating countries, and across PISA cycles;
- A description of performance across different mathematical processes and content areas;
- A description of mathematics performance based on the percentages of students achieving different mathematics proficiency levels in Ireland and on average across OECD countries, and across PISA cycles with particular reference to the 2012 cycle;
- An examination of key factors associated with achievement in PISA 2022 in Ireland including student-level gender, immigrant and socioeconomic status, and school sector gender-composition, and DEIS status in 2022, and across PISA cycles;
- A summary of key findings from the chapter.

As noted in Chapter 1, Ireland's weighted student-level response rate in PISA 2022 (76.8%) fell below the minimum threshold outlined by the PISA Technical Standards (80%). As a result, it was necessary to carry out a Non-Response Bias Analysis (NRBA) to assess the potential for bias in the PISA estimates for Ireland. This analysis indicated an upward bias of approximately one-tenth of a standard deviation (SD) in the achievement estimates for Ireland (which equates to about 8 or 9 points on the PISA scale), and that the bias was likely to be larger for male students and students in DEIS schools. This means that the estimates presented in this chapter are likely to be somewhat of an overestimation of Ireland's 'true' performance if all selected students had completed the test (see Section 1.7 and Donohue et al., 2023a for more information). The figures presented in this chapter should be interpreted with consideration of the results of the NRBA and particular caution should be applied when comparisons are made with the findings from previous cycles and among subgroups of the population.

3.1 Framework for Mathematics

This section describes the PISA 2022 mathematics framework, and then examines how the new mathematics items for the 2022 cycle relate to that framework.

A new mathematical literacy framework was developed for the PISA 2022 cycle, as mathematics was the main domain. PISA 2022 is the first time mathematics has been the main domain since 2012. The PISA 2022 framework remains consistent with the principles of the 2012 framework, though a number of key changes can be observed.

The new framework considers mathematics in the context of a world that is constantly changing in response to technological developments. New elements of this framework are an increased focus on mathematical reasoning, the necessity for students to understand computational thinking concepts central to technological advancements, and a recognition of the widespread availability of computer-based assessment to PISA students (OECD, 2023a).

3.1.1 Definition of mathematical literacy

A good understanding of mathematics is a critical element in young people's preparedness for meaningful participation in society. Increasingly, a minimum level of understanding of mathematics is required to take on everyday challenges and situations both in the professional and personal spheres.

The definition of mathematical literacy in PISA 2022 is as follows:

> Mathematical literacy is an individual's capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to know the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective 21st Century citizens (OECD, 2023a, p.22).

This definition has evolved from those employed in the 2003 and 2012 cycles, shifting the emphasis away from a focus on the computation of basic calculations, towards a recognition that students are now performing in rapidly-changing contexts driven by new technologies. In this changing world, students are required to be creative, engaged, and capable of making judgements both for society and for themselves.

The new definition includes within it an implicit recognition of the importance of students developing a solid understanding of key mathematical concepts, and the capacity to actively use those ideas and processes in real-world, contemporary contexts.

3.1.2 Mathematical processes and underlying mathematical capabilities

In a departure from previous mathematics frameworks, the 2022 PISA framework brings the concept of mathematical reasoning to the fore. Reasoning is presented as a key competency, necessary for navigating the contemporary world. It is the ability to reason logically and present cogent arguments, providing results that can be relied upon in real-life contexts. Mathematical reasoning is a core aspect of being mathematically literate.

Six key understandings underpin this notion of mathematical reasoning. They are:

- understanding quantity, number systems and their algebraic properties;
- appreciating the power of abstraction and symbolic representation;
- seeing mathematical structures and their regularities;
- recognising functional relationships between quantities;
- using mathematical modelling as a lens onto the real world (e.g., those arising in the physical, biological, social, economic and behavioural sciences); and
- understanding variation as the heart of statistics.

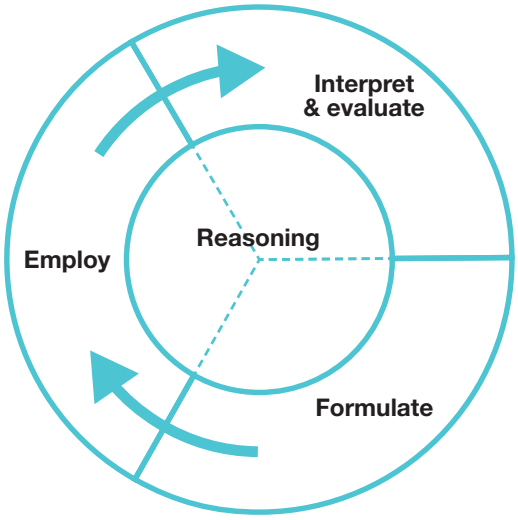
Three key processes are incorporated into mathematical reasoning:

Formulate **–** this process refers to the student's ability to recognise and identify opportunities to use mathematics in a given context, and provide mathematical structure to a problem presented. A process akin to translation is employed, whereby a real-world problem is translated into the domain of mathematics, providing mathematical structure, representations and specificity to the problem, which can then be analysed, set up, and ultimately solved.

Employ **–** this process involves applying mathematical reasoning and using mathematical concepts, procedures, facts and tools to arrive at a mathematical solution. It includes performing calculations, manipulating algebraic expressions and equations or other mathematical models, analysing information in a mathematical manner from mathematical diagrams and graphs, as well as developing mathematical descriptions and explanations and using mathematical tools to solve problems.

Interpret and Evaluate **–** this process involves reflecting upon mathematical solutions or results and interpreting them in context. It includes evaluating mathematical solutions or reasoning in relation to the context of the problem and determining whether the results are reasonable and, importantly, whether they make sense in the situation (OECD, 2023a).

Figure 3.1. Mathematical literacy: the relationship between mathematical reasoning and the problem solving (modelling) cycle.



Source: (OECD, 2023a, p.23).

The individual PISA mathematics items are designed in such a way as to mainly draw on one of these processes.

The framework also identifies various student actions for each of these mathematical processes in order to link them with mathematical capabilities. Building on this, each of the proficiency levels used to report performance on mathematics describe a set of capabilities that students performing at that level typically posess (see Section 3.4 for more information on the proficiency levels used in PISA).

3.1.3 Mathematical content areas

The four mathematical content categories that were used in PISA 2012 were again in use in 2022. They reflect the mathematical phenomena that underlie the major strands of school curricula, the structure of mathematics itself, and broad classes of problems. They are:

- ***Change & relationships:*** this content area refers to students' ability to understand types of change as well as recognising when they occur so that appropriate mathematical models can be used to describe and predict change. In mathematical terms, this means modelling the change and the relationships with appropriate functions and equations, and also creating, interpreting and translating among symbolic and graphical representations of relationships.
- ***Space & shape:*** this content domain covers a range of phenomena such as patterns, properties of objects, positions and orientations, representations of objects, decoding and encoding of visual information and navigation and interaction with real shapes and representations. Geometry is central to space and shape but the content area draws on other mathematical areas such as spatial visualisation, measurement and algebra.
- ***Quantity:*** the quantity content area involves understanding measurements, counts, magnitudes, units, indicators, relative size, and numerical trends and patterns. It incorporates the quantification of attributes of objects, relationships, situations and entities in the world, understanding various representations of those quantifications and judging interpretations and arguments based on quantity.
- ***Uncertainty & data:*** this content category includes understanding variation in processes and the quantification of that variation; recognising uncertainty and error in measurement, and knowledge of chance. It also includes forming, interpreting and evaluating conclusions drawn in situations where uncertainty is central.

Students must draw on these content areas to reason, formulate the problem, solve the mathematical problem once formulated, and then to interpret and evaluate the proposed solution.

In PISA, it is important that a wide variety of contexts is used, as the definition of mathematical literacy envisions mathematics being used to solve a problem set within concrete contexts. The choice of appropriate mathematical strategies and representations is often dependent on the context in which a problem is encountered. As in previous PISA mathematics frameworks, the context areas used to define real-world situations are personal, occupational, societal, and scientific.

3.1.4 21st Century skills

For the first time, the PISA 2022 mathematics framework includes selected 21st Century skills. These skills will be vital to learning and participation in the coming years. The PISA 2022 framework has selected the following skills for inclusion in the 2022 assessment:

- ***Critical thinking***
- ***Creativity***
- ***Research and inquiry***
- ***Self-direction, initiative, and persistence***
- ***Information use***
- ***Systems thinking***
- ***Communication***
- ***Reflection***

Although the item development process recognised these 21st Century skills, it is important to note that mathematics items in PISA 2022 were not specifically developed to align with these skills.

3.1.5 Item types and distribution of mathematics items by framework components

As mathematics was the major domain for 2022, a large number of mathematics items were used in the assessment, aiming to achieve a balance across processes and content subscales. A total of 234 test questions were included in the mathematics computer-based assessment; 74 of them were trend items, meaning they had been used in previous cycles of PISA (ETS, 2023), while 160 of them were new.

In keeping with previous cycles, three types of response format were used to assess mathematics in PISA 2022: open constructed-response items, closed constructed-response items, and selected response (simple or complex) items. Open response items require extended written responses from students. These are later manually coded by trained experts. Closed constructed-response items assess students' knowledge and skills within a structured response setting that can be easily judged as correct or incorrect. These answers can be coded manually or automatically. Lastly, selected-response (simple and complex multiple-choice) items prompt students to choose one or more responses from a number of provided options. These items are generally machine coded.

Table 3.1 provides information on the distribution of mathematics items across categories or dimensions of the assessment framework. Smaller percentages of items examined the formulating (21%), reasoning processes (23%), and interpreting (24%) processes than the employing (32%) process, though each subprocess ultimately represents 25% of the score points in PISA 2022. A similar pattern can be observed in the content subscales, where a smaller percentage of items examined space & shape (18%) as a subscale compared to those examining change & relationships (24%), uncertainty & data (26%), and quantity (32%).

Table 3.1 also shows that 42% of items were either simple or complex multiple-choice items, while the remainder were constructed response items that were either human-coded or computer-coded.

Table 3.1. Distribution of PISA 2022 mathematics items by process, content area, item format and context

Component	Number	%	% of score points in PISA 2022	Component	Number	%
Process				**Item Format**		
Reasoning	54	23%	Approx 25%	Simple multiple choice	98	42%
Formulating	48	21%	Approx. 25%	Complex multiple choice	49	21%
Employing	75	32%	Approx. 25%	Open response – human coded	35	15%
Interpreting	57	24%	Approx. 25%	Open response – computer-coded	52	22%
Total	234	100%	100%	Total	234	100%
Content				**Context**		
Change & relationships	55	24%	Approx. 25	Occupational	50	21%
Quantity	76	32%	Approx. 25	Personal	60	26%
Space & shape	43	18%	Approx. 25	Scientific	70	30%
Uncertainty & data	60	26%	Approx. 25	Societal	54	23%
Total	234	100%	100%	Total	234	100%

Source: Adapted from OECD 2023 (in press), Table 3.2, OECD 2023a, Tables 2.1 and 2.2, and ETS 2021, Tables 1-4.

3.2 Overall Performance on Mathematics

This section looks at Ireland's mean achievement in mathematics in PISA 2022, presents international comparisons, and then proceeds to examine 2022 achievement against Ireland's performance in selected previous cycles of PISA.

Mathematics was assessed as the major domain in PISA 2022. The 2022 cycle is the third cycle in which mathematics has been administered on computer in most participating countries. The last time mathematics was the major domain was in 2012, and some analysis in this chapter will refer to the 2012 cycle and results as a reference point for this reason.

In 2022, Ireland's mean score on the overall mathematics scale is 491.6 and this is significantly higher than the OECD average of 472.4. Applying a 95% confidence interval, which takes account of measurement and sampling error, Ireland's mean mathematics score falls between 487.7 and 495.6.[29] When this range is considered, Ireland's mean mathematics performance is placed between 5th and 18th among OECD countries, and between 9th and 22nd among all 81 participating countries/economies.

Table 3.2 outlines the mean score, and SD of each country/economy participating in PISA 2022. In mathematics, Singapore outperformed all other participating countries/economies with a mean of 574.7. Nine economies achieved a mean mathematics score that is significantly higher than Ireland's (Singapore, Macao, Chinese Taipei, Hong Kong, Japan, Korea, Estonia, Switzerland, and

[29] Ireland's reported mean, 491.6, is the midpoint in this range

Canada), while Ireland's mean mathematics performance does not differ from that of eight countries/economies (Netherlands, Belgium, Denmark, United Kingdom, Poland, Austria, Australia, and Czech Republic). On the other hand, 63 economies performed significantly less well than Ireland in mathematics.

The mean mathematics score for Northern Ireland is 475.1 (SE = 3.0, SD = 92.3 see E-Appendix Table 3.1). This is significantly different from the mean score for Ireland, but not significantly different from the OECD average (OECD 2023c, Table I.B2.1). The EU average score in mathematics is 471.9. This is significantly lower than the mean score for Ireland. Of the participating EU countries, Ireland performs significantly below one other country in mathematics - Estonia (509.9). Ireland's performance is not significantly different from six other EU countries: Netherlands (492.7), Belgium (489.5), Denmark (489.3), Poland (489.0), Austria (487.3) and Czech Republic (487.0).

Table 3.2 also shows the SD for each country/economy participating in PISA 2022. Ireland's SD for mathematics is 79.6, while the OECD average is 90.1. This indicates that Ireland has a narrower spread of mathematics achievement than on average across OECD countries. Indeed, the spread in Ireland is among the lowest across OECD countries, with only Costa Rica (65.7), Mexico (69.4), Colombia (72.8) and Chile (76.6) having lower SDs.[30] Notably, the SD for Northern Ireland (92.3) is larger than Ireland's (79.6).

[30] Latvia (SD 80.1) has a similar standard deviation to Ireland

Table 3.2. Mean scores, standard deviations (SD) and standard errors (SE) for all countries/economies, the OECD average and the EU average on the overall mathematics scale, and positions relative to OECD average and mean score for Ireland.

	Mean	SE	SD	SE	IRL		Mean	SE	SD	SE	IRL
Singapore	574.7	(1.2)	102.8	(0.9)	▲	*United Arab Emirates*	431.1	(0.9)	101.4	(0.6)	▼
Macao (China)	551.9	(1.1)	92.5	(1.0)	▲	Greece	430.1	(2.3)	83.4	(1.3)	▼
Chinese Taipei	547.1	(3.8)	111.9	(2.3)	▲	*Romania*	427.8	(4.0)	98.5	(2.0)	▼
*Hong Kong (China)**	540.4	(3.0)	104.5	(1.7)	▲	*Kazakhstan*	425.4	(1.7)	78.4	(1.0)	▼
Japan	535.6	(2.9)	92.8	(1.9)	▲	*Mongolia*	424.6	(2.6)	83.3	(1.6)	▼
Korea	527.3	(3.9)	105.2	(2.6)	▲	*Cyprus*	418.3	(1.2)	100.7	(0.9)	▼
Estonia	509.9	(2.0)	84.9	(1.1)	▲	*Bulgaria*	417.3	(3.3)	96.8	(2.1)	▼
Switzerland	508.0	(2.1)	96.0	(1.2)	▲	*Moldova*	414.2	(2.3)	79.5	(1.3)	▼
Canada*	496.9	(1.6)	94.0	(0.8)	▲	*Qatar*	414.1	(1.1)	88.8	(1.0)	▼
Netherlands*	492.7	(3.8)	106.1	(2.1)	O	Chile	411.7	(2.1)	76.6	(1.1)	▼
Ireland*	491.6	(2.0)	79.6	(0.9)		*Uruguay*	408.7	(2.0)	83.2	(1.3)	▼
Belgium	489.5	(2.2)	96.3	(1.1)	O	*Malaysia*	408.7	(2.4)	75.7	(2.4)	▼
Denmark*	489.3	(1.9)	81.6	(1.1)	O	*Montenegro*	405.6	(1.1)	81.6	(0.9)	▼
United Kingdom*	489.0	(2.2)	96.4	(1.3)	O	*Baku (Azerbaijan)*	396.9	(2.4)	85.1	(1.1)	▼
Poland	489.0	(2.3)	89.5	(1.4)	O	Mexico	395.0	(2.3)	69.4	(1.4)	▼
Austria	487.3	(2.3)	93.6	(1.2)	O	*Thailand*	393.9	(2.7)	75.7	(2.0)	▼
Australia*	487.1	(1.8)	99.3	(1.0)	O	*Peru*	391.2	(2.3)	77.9	(1.2)	▼
Czech Republic	487.0	(2.1)	93.4	(1.2)	O	*Georgia*	390.0	(2.4)	84.5	(2.2)	▼
Slovenia	484.5	(1.2)	89.2	(1.0)	▼	*Saudi Arabia*	388.8	(1.8)	65.6	(1.0)	▼
Finland	484.1	(1.9)	89.3	(0.9)	▼	*North Macedonia*	388.6	(0.9)	82.7	(0.9)	▼
Latvia*	483.2	(2.0)	80.1	(1.2)	▼	Costa Rica	384.6	(1.9)	65.7	(1.4)	▼
Sweden	481.8	(2.1)	95.6	(1.1)	▼	Colombia	382.7	(3.0)	72.8	(1.5)	▼
New Zealand*	479.1	(2.0)	98.5	(1.4)	▼	*Brazil*	378.7	(1.6)	76.6	(1.2)	▼
Lithuania	475.1	(1.8)	87.2	(1.3)	▼	*Argentina*	377.5	(2.3)	74.4	(1.1)	▼
Germany	474.8	(3.1)	94.7	(1.3)	▼	*Jamaica**	377.4	(3.1)	71.2	(1.4)	▼
France	473.9	(2.5)	91.1	(1.1)	▼	*Albania*	368.2	(2.1)	84.9	(1.3)	▼
Spain	473.1	(1.5)	86.4	(0.8)	▼	*Palestinian Authority*	365.7	(1.8)	65.9	(1.1)	▼
Hungary	472.8	(2.5)	93.9	(1.7)	▼	*Indonesia*	365.5	(2.4)	62.3	(1.3)	▼
Portugal	471.9	(2.4)	89.6	(1.5)	▼	*Morocco*	364.8	(3.4)	62.7	(2.1)	▼
Italy	471.3	(3.1)	88.9	(1.6)	▼	*Uzbekistan*	363.9	(2.0)	67.0	(1.0)	▼
Viet Nam	469.4	(3.9)	85.8	(2.3)	▼	*Jordan*	361.2	(2.0)	61.7	(1.0)	▼
Norway	468.4	(2.1)	93.5	(0.9)	▼	*Panama**	356.6	(2.8)	65.4	(2.1)	▼
Malta	466.0	(1.6)	98.5	(1.4)	▼	*Kosovo*	355.0	(1.0)	62.4	(0.7)	▼
United States*	464.9	(4.0)	94.5	(1.8)	▼	*Philippines*	354.7	(2.6)	64.7	(1.8)	▼
Slovak Republic	464.0	(2.9)	101.1	(1.8)	▼	*Guatemala*	344.2	(2.2)	68.7	(1.7)	▼
Croatia	463.1	(2.4)	87.9	(1.4)	▼	*El Salvador*	343.5	(2.0)	59.4	(1.1)	▼
Iceland	458.9	(1.6)	87.8	(1.2)	▼	*Dominican Republic*	339.1	(1.6)	54.0	(1.3)	▼
Israel	457.9	(3.3)	107.1	(1.9)	▼	*Paraguay*	337.5	(2.2)	77.4	(1.1)	▼
Türkiye	453.2	(1.6)	89.8	(1.0)	▼	*Cambodia*	336.4	(2.7)	72.5	(1.6)	▼
Brunei Darussalam	442.1	(0.9)	83.7	(0.7)	▼						
Ukrainian regions (18 of 27)	440.8	(4.1)	87.9	(2.1)	▼	OECD Average	472.4	(0.4)	90.1	(0.2)	▼
Serbia	439.9	(3.0)	89.6	(2.7)	▼	EU Average	471.9	(0.5)	91.5	(0.3)	▼

	Significantly above OECD average		▲	Significantly higher than Ireland
	At OECD average		O	Not significantly different from Ireland
	Significantly below OECD average		▼	Significantly lower than Ireland

OECD countries are in regular font, partner countries/economies are in *italics*.

Source: OECD 2023c, Table I.B1.2.1.

*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

Estimates for United Kingdom include data from Northern Ireland, Scotland, Wales and England. Achievement data for Northern Ireland are described in each chapter and in tabular form in the E-Appendix.

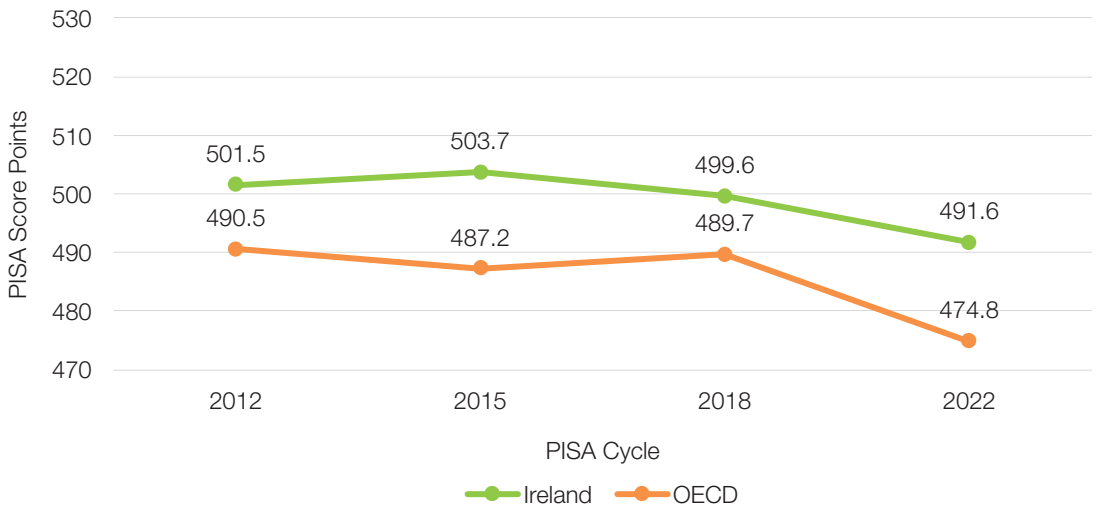
3.2.1 Trends in mathematics performance

Ireland's 2022 mathematics achievement can also be considered in the context of Ireland's performance in previous cycles of PISA. Comparisons are made back to 2012, when mathematics was last assessed as a major domain. This chapter also contains analyses that make reference to a number of comparison countries. These countries were selected on the basis that they have high levels of performance or share certain key characteristics with Ireland (for example size or language of instruction among other features) and to provide continuity of interpretation with the 2018 PISA reporting.

As with all trend analysis for Ireland, differences between PISA cycles should be interpreted with consideration of the known bias that is present in the 2022 estimates. In 2012, students in Ireland achieved a mean mathematics score of 501.5, which is not significantly different from the mean score in 2018 (499.6) (Figure 3.2). Ireland's mean score in 2022 is significantly different from both these scores. Therefore, in 2022, Ireland has seen a significant decrease of 9.8 PISA score points, when compared to 2012, and 8.0 score points when compared to 2018.

On average across OECD countries, performance remained relatively stable between 2012 (490.5) and 2018 (489.7) but decreased to an average of 474.8 in 2022. This constitutes a 15.7-point drop when compared to 2012, and a 14.8-point decrease when compared to 2018. Both these decreases are statistically significant.

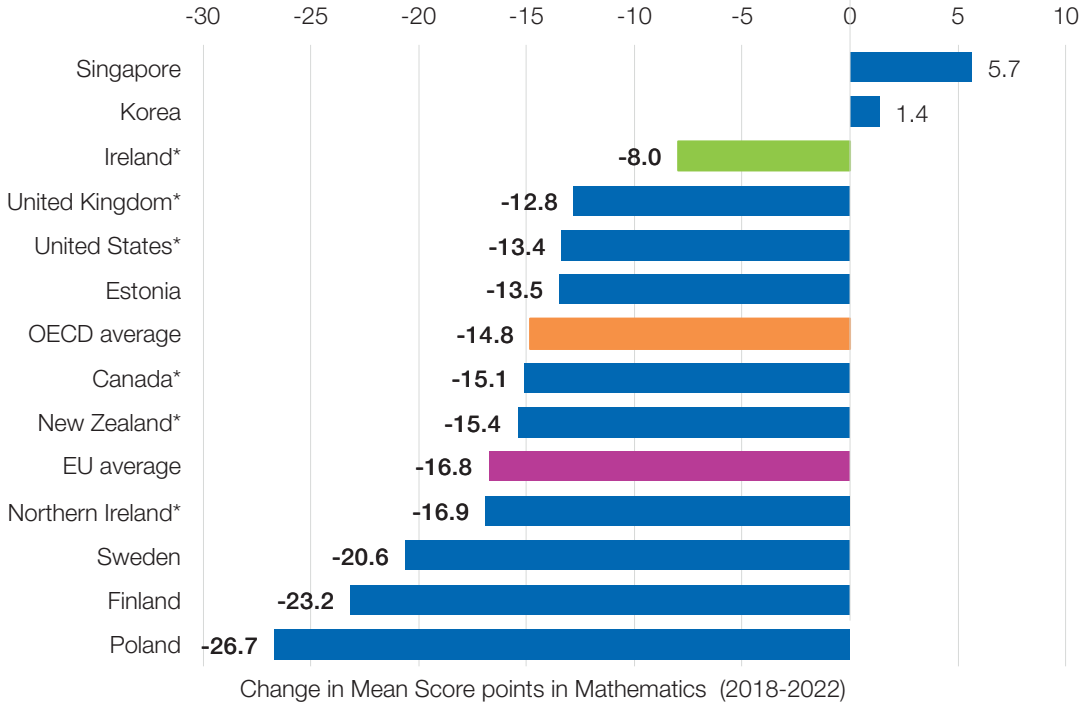
Figure 3.2. Mean scores on the overall mathematics scale in Ireland, and on average across the OECD, 2012-2022



Source: OECD 2023c, Table I.B1.5.4.
* OECD averages are based on the arithmetic average across OECD countries, excluding Costa Rica, Luxembourg and Spain

Figure 3.3 presents the mean score differences in mathematics performance between 2018 and 2022 for selected countries/economies, the OECD average, the EU average, and Northern Ireland. On average across the OECD countries, there was a drop in performance of 14.8 points on the PISA scale; this was larger than the drop seen in Ireland (8.0 points). An increase of 5.7 and 1.4 score points can be observed in Singapore and Korea respectively, though these increases are not statistically significant. Ireland's decrease of 8.0 score points compared to 2018 is statistically significant, as are the other decreases noted in **bold**.

Figure 3.3 Change in mean achievement in mathematics PISA 2018-2022 in selected comparator countries, OECD and EU averages



Source: OECD 2023c, Table I.B1.5.4 and Table I.B2.1 (data for Northern Ireland).
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.
See E-Appendix Table 3.4.

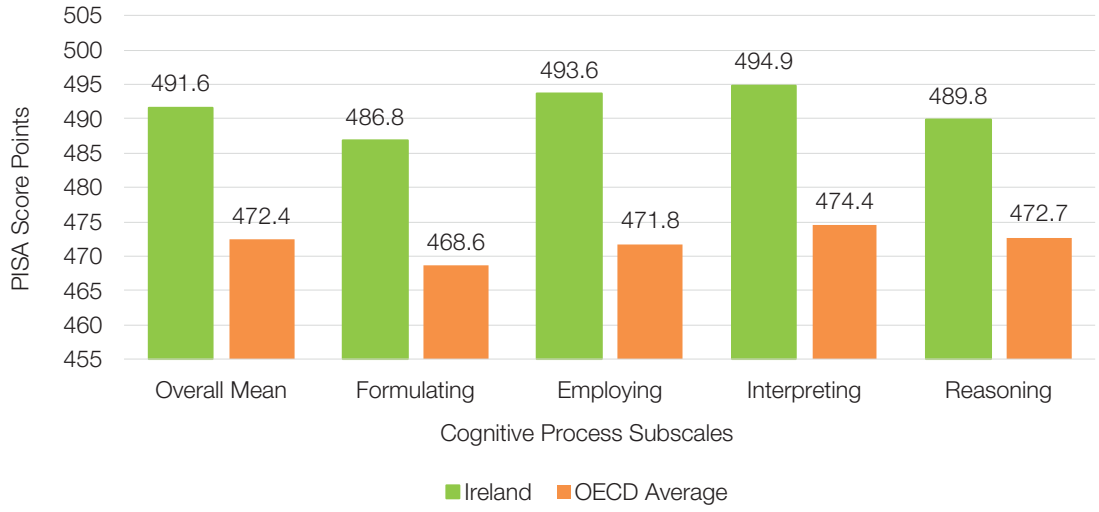
3.3 Performance on Mathematics Subscales

Performance in PISA mathematics is also measured across a number of process and content subscales. As outlined in the mathematics framework (OECD, 2023a), each mathematics item can be classified according to a cognitive process (formulating, employing, interpreting, reasoning) and a content area (change & relationships, quantity, space & shape, uncertainty & data). This section presents an overview of Ireland's performance on each of these subscales, compared to the OECD average. More details on student performance on each subscale internationally can be found in *PISA Results 2022. Volume I: The state of learning and equity in education* (OECD, 2023c).

3.3.1 Performance on process subscales

Figure 3.4 presents Ireland's performance on the four cognitive process subscales outlined in the updated PISA 2022 mathematics framework. Students in Ireland perform highest on the interpreting (494.9) and employing (493.6) subscales, and somewhat lower on the reasoning (489.8) and formulating (486.8) subscales. Ireland's performance on each of the subscales is higher than the OECD average, with a difference of 18.1 score points on the formulating subscale, 21.8 points for employing, 20.4 for interpreting, and 17.2 for reasoning.

Figure 3.4. Mean scores on the overall mathematics scale and the mathematical process subscales, in Ireland and on average across OECD countries

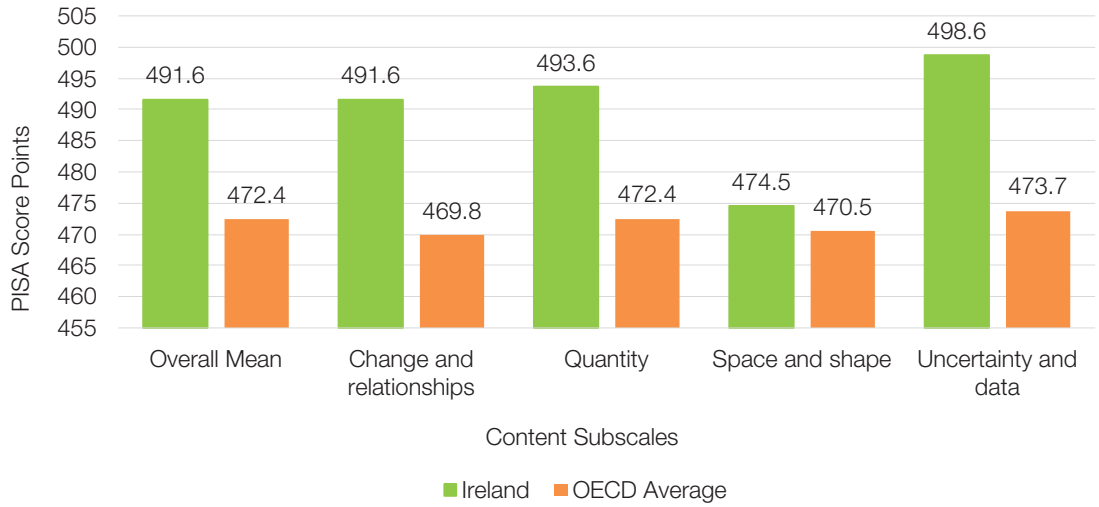


Source: OECD 2023c, Tables I.B1.2.1, I.B1.2.4, I.B1.2.5, I.B1.2.6 and I.B1.2.7.
Note: OECD average includes 37 OECD countries participating in PISA 2022.

3.3.2 Performance on content subscales

In addition, four content areas are outlined in the PISA mathematics framework. Students in Ireland performed highest in uncertainty & data (498.6) and in quantity (493.6). Performance on change & relationships (491.6) is similar. However, the performance of students in Ireland on space & shape is considerably lower (474.5). This is consistent with patterns observed in the 2012 cycle of PISA when scores for the mathematics content subscales were last computed (see Perkins et al., 2013). Ireland's performance on each of the content subscales is higher than the OECD average, with a difference of 24.9 score points for uncertainty & data, 21.8 for change & relationships, and 21.2 for quantity. Ireland's performance on space & shape, however, is much closer to the OECD average.

Figure 3.5. Mean scores on the overall mathematics scale and the content subscales, in Ireland, and on average across OECD countries



Source: OECD 2023c, Tables I.B1.2.1, I.B1.2.8, I.B1.2.9, I.B1.2.10 and I.B1.2.11.
Note: OECD average includes 37 OECD countries participating in PISA 2022.

3.4 Performance on Mathematics Proficiency Levels

Another perspective on achievement can be gained by examining a country's achievement across a set of proficiency levels. This section outlines the eight proficiency levels used to describe the distribution of mathematics achievement across higher- and lower-achievers, before considering Ireland's achievement across the proficiency levels and the OECD average.

The PISA Proficiency Levels describe the kind of tasks students can carry out at a given level. In previous cycles of PISA, just six proficiency levels were used to report on mathematics performance. However, in PISA 2022, this has increased to eight levels of proficiency. The levels range from Level 1 to Level 6, with Level 1 now divided into three subcategories: 1a, 1b, and 1c (see Table 3.3 for a description of each level). Level 1a is equivalent to the Level 1 described in previous PISA cycles, as both categories have the same lower score cut off (357.77 points).

In PISA, students performing at Level 2 are considered to be at the baseline proficiency that students need to participate fully in society. Those found at Levels 5 and 6 are performing at the highest levels, and are able to answer the most difficult items on the PISA test.

Table 3.3. Summary description of the eight levels of proficiency on the mathematics scale in PISA 2022, and percentages of students achieving each level, in Ireland and on average across OECD and EU countries

Level (Cut-point)	Students at this level can:	Ireland		OECD Avg		EU Avg	
		%	SE	%	SE	%	SE
6 (669.30 and above)	Work through abstract problems and demonstrate creativity and flexible thinking to develop solutions. For example, they can recognise when a procedure that is not specified in a task can be applied in a non-standard context, or when demonstrating a deeper understanding of a mathematical concept is necessary as part of a justification. They can link different information sources and representations, including effectively using simulations or spreadsheets as part of their solution. Students at this level are capable of critical thinking and have a mastery of symbolic and formal mathematical operations and relationships that they use to clearly communicate their reasoning. They can reflect on the appropriateness of their actions with respect to their solution and the original situation.	1.0	(0.2)	2.0	(0.0)	1.6	(0.0)
5 (606.99 to less than 669.30)	Develop and work with models for complex situations, identify or impose constraints, and specify assumptions. They can apply systematic, well-planned problem-solving strategies for dealing with more challenging tasks, such as deciding how to develop an experiment, designing an optimal procedure, or working with more complex visualisations that are not given in the task. Students demonstrate an increased ability to solve problems whose solutions often require incorporating mathematical knowledge that is not explicitly stated in the task. Students at this level reflect on their work and consider mathematical results with respect to the real-world context.	6.2	(0.5)	6.7	(0.1)	6.3	(0.1)

Level (Cut-point)	Students at this level can:	Ireland		OECD Avg		EU Avg	
		%	SE	%	SE	%	SE
4 (544.68 to less than 606.99)	Work effectively with explicit models for complex concrete situations, sometimes involving two variables, as well as demonstrate an ability to work with undefined models that they derive using a more sophisticated computational-thinking approach. Students at this level begin to engage with aspects of critical thinking, such as evaluating the reasonableness of a result by making qualitative judgements when computations are not possible from the given information. They can select and integrate different representations of information, including symbolic or graphical, linking them directly to aspects of real-world situations. At this level, students can also construct and communicate explanations and arguments based on their interpretations, reasoning, and methodology.	18.8	(0.7)	14.9	(0.1)	15.2	(0.1)
3 (482.38 to less than 544.68)	Devise solution strategies, including strategies that require sequential decision-making or flexibility in understanding of familiar concepts. At this level, students begin using computational-thinking skills to develop their solution strategy. They are able to solve tasks that require performing several different but routine calculations that are not all clearly defined in the problem statement. They can use spatial visualisation as part of a solution strategy or determine how to use a simulation to gather data appropriate for the task. Students at this level can interpret and use representations based on different information sources and reason directly from them, including conditional decision-making using a two-way table. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships	29.0	(0.9)	22.0	(0.1)	23.0	(0.2)
2 (420.07 to less than 482.38)	Recognise situations where they need to design simple strategies to solve problems, including running straightforward simulations involving one variable as part of their solution strategy. They can extract relevant information from one or more sources that use slightly more complex modes of representation, such as two-way tables, charts, or two-dimensional representations of three-dimensional objects. Students at this level demonstrate a basic understanding of functional relationships and can solve problems involving simple ratios. They are capable of making literal interpretations of results.	25.9	(0.8)	23.3	(0.1)	23.9	(0.2)
1a (357.77 to less than 420.07)	Answer questions involving simple contexts where all information needed is present, and the questions are clearly defined. Information may be presented in a variety of simple formats and students may need to work with two sources simultaneously to extract relevant information. They are able to carry out simple, routine procedures according to direct instructions in explicit situations, which may sometimes require multiple iterations of a routine procedure to solve a problem. They can perform actions that are obvious or that require very minimal synthesis of information, but in all instances the actions follow clearly from the given stimuli. Students at this level can employ basic algorithms, formulae, procedures, or conventions to solve problems that most often involve whole numbers.	14.2	(0.7)	18.7	(0.1)	18.0	(0.1)

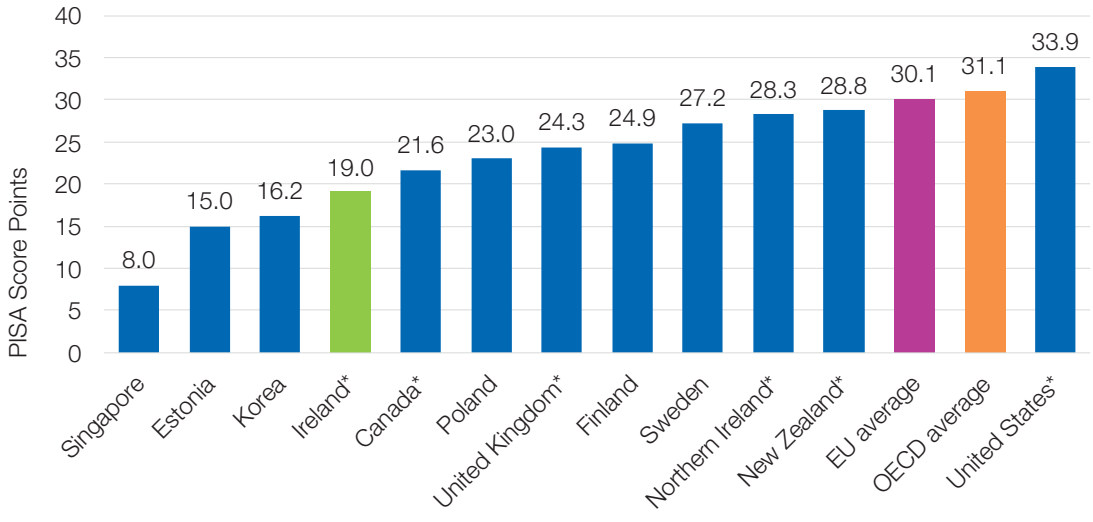
Level (Cut-point)	Students at this level can:	Ireland		OECD Avg		EU Avg	
		%	SE	%	SE	%	SE
1b (295.47 to less than 357.77)	Respond to questions involving easy to understand contexts where all information needed is clearly given in a simple representation (i.e., tabular or graphic) and, as necessary, recognise when some information is extraneous and can be ignored with respect to the specific question being asked. They are able to perform simple calculations with whole numbers, which follow from clearly prescribed instructions, defined in short, syntactically simple text.	4.2	(0.4)	9.8	(0.1)	9.3	(0.1)
1c (233.17 to less than 295.47)	Respond to questions involving easy to understand contexts where all relevant information is clearly given in a simple, familiar format (for example, a small table or picture) and defined in a very short, syntactically simple text. They are able to follow a clear instruction describing a single step or operation.	0.5	(0.1)	2.3	(0.1)	2.5	(0.1)
Below 1c (below 233.17)		0.0	(0.0)	0.3	(0.0)	0.3	(0.0)

Source: Adapted from OECD 2023a, Table 2.4, OECD 2023c, Table I.B1.3.1. See E-Appendix Tables 3.2 and 3.3.

In Ireland, 19.0% of students perform below Level 2 on PISA mathematics, compared with 31.1% on average across OECD countries, and 28.7% on average across the EU countries participating (Figure 3.6). Seven, mostly east Asian, countries (Korea, Estonia, Chinese Taipei, Hong Kong, Japan, Macao and Singapore) had lower percentages of students performing below Level 2 than Ireland.

Figure 3.6 shows the percentages of students in Ireland performing below Level 2, compared to selected comparator countries, and the OECD and EU averages. Of the selected comparison countries, only three countries have fewer students than Ireland performing below Level 2 (Korea with 16.2%, Estonia with 15.0% and Singapore with 8.0% of students).

Figure 3.6. Percentages of students performing below Proficiency Level 2 on the mathematics scale in Ireland, in selected comparison countries, and on average across OECD and EU countries

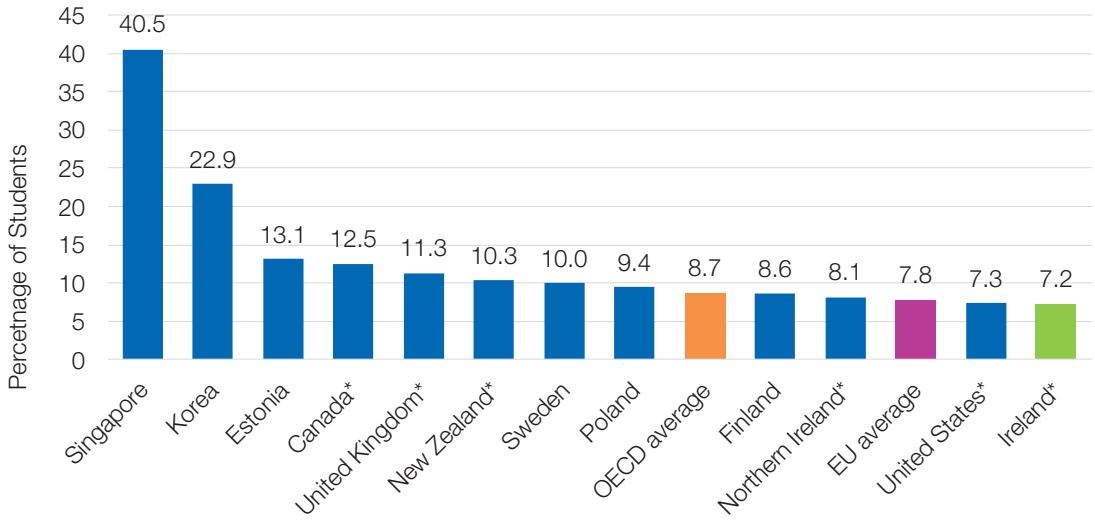


Source: Adapted from OECD 2023c, Tables I.B1.3.1 and I.B1.5.1.
Note: OECD average includes 37 OECD countries participating in PISA 2022.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

Figure 3.7 instead, represents the percentages of students in Ireland performing at Levels 5 and 6 in Ireland, compared with the selected comparator countries and the OECD and EU averages. In Ireland, 7.2% of students in perform at or above Level 5 (Figure 3.7). This is lower than the OECD average of 8.7%, and close to the EU average of 7.9%. Of all 81 countries/economies participating in PISA 2022, 28 countries/economies had greater proportions of top-performing students than Ireland.

Each of the selected comparison countries have higher proportions of students than Ireland performing at or above Level 5 including Poland (9.4%), Sweden (10%), United Kingdom (11.3%), Canada (12.5%), and Estonia (13.1%). While United Kingdom and Poland had mean scores that were not significantly different from Ireland, they had higher percentages of students performing at or above Level 5 (11.3% and 9.4% respectively). Sweden and New Zealand also had higher percentages of top performing students (10.0% and 10.3%, respectively) than Ireland, even though their overall mean performance was significantly below Ireland's. In Singapore, the highest achieving country, the percentage of students performing at Level 5 or above (40.5%) far exceeds the percentage in any other country.

Figure 3.7. Percentages of students performing at or above Proficiency Level 5 on the mathematics scale in Ireland, in selected comparison countries, and on average across OECD and EU countries



Source: Adapted from OECD 2023c, Table I.B1.3.1 and Table I.B1.5.1.
Note: OECD average includes 37 OECD countries participating in PISA 2022.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

3.4.1 Trends in mathematics proficiency levels

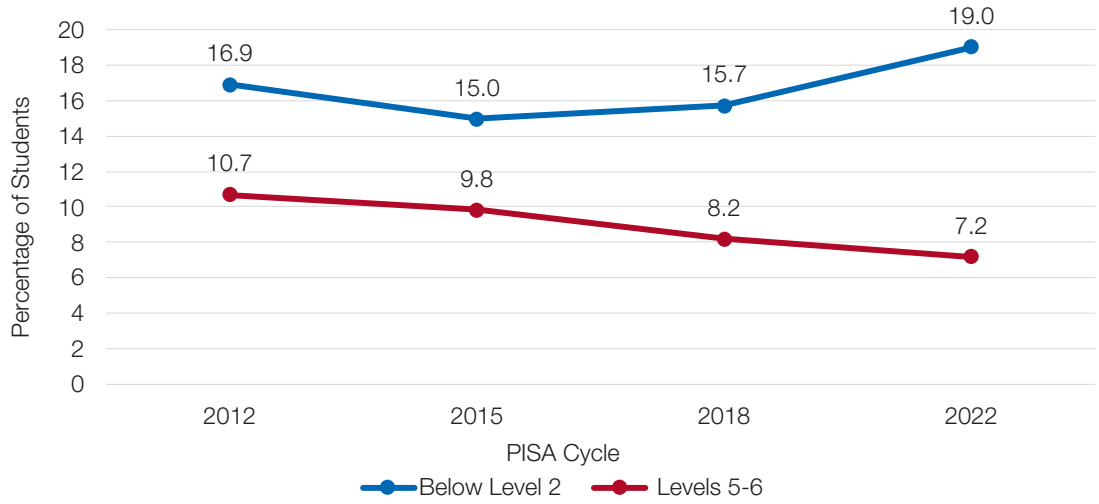
This section looks at trends in mathematical proficiency levels, noting that, as with all trend analysis for Ireland, differences between PISA cycles should be interpreted with consideration of the known bias in the 2022 estimates. The figure for students performing below Level 2 (19.0%) in 2022 is higher than 2018, when 15.7% of students in Ireland were recorded at this level, and 16.9% in 2012 when mathematics was last the main domain. The difference of 3.3 percentage points between 2022 and 2018 is statistically significant. However, there is no significant difference between the percentages of students performing below Level 2 in the 2022 and 2012 cycles.

On average, across OECD countries, the percentage of students performing below Level 2 was 24.4% in 2012, and 23.9% in 2018, before increasing to 30.0% in 2022. When comparing the 2022 average

with previous cycles (2012 and 2018) the differences are statistically significant (5.6% and 6.2%, respectively).[31]

Students performing above Level 5 accounted for 10.7% of students in Ireland in 2012, while they represented 8.2% in 2018, before decreasing again to 7.2% in 2022. The difference of 3.4 percentage points between the 2022 and 2012 cycles is statistically significant. However, the difference of 1.0 percentage point between the 2022 and 2018 cycles is not significant.

Figure 3.8. Percentage of students below Proficiency Level 2 and at or above Proficiency Level 5 on overall mathematics in Ireland, 2012-2022



Source: OECD 2023c, Table I.B1.5.1.

3.5 Performance by Selected Variables

This section examines key context variables such as gender, immigration status, students Economic, Social and Cultural Status (ESCS), school sector and gender composition, and school DEIS status, and relates them to the overall mathematics performance of students in Ireland.

3.5.1 Mathematics performance by gender

Of participating students, 48.7% of students were female, while 51.3% were male (weighted percentages). In Ireland, male students achieved a mean score of 497.8 in mathematics, while female students achieved a mean score of 485.1 (Table 3.4). This compares to an OECD average mean score of 476.9 for males and 467.8 for females. The gender difference in Ireland (12.7 score points) is statistically significant, and is larger than the OECD average difference (9.1 score points) in favour of males.

Two comparison countries had a slightly larger gender difference in favour of male students; United Kingdom (14.4 score points), and United States (13.3 score points), while just one of our comparison

[31] Note that the OECD average used for trend comparison excludes Costa Rica, Spain and Luxembourg, and differs from the average provided for 2022 analysis (which includes data for 37 OECD countries including Costa Rica).

countries (Finland) had a statistically significant difference in favour of female students (5.1 score points). No significant performance differences were noted between males and females in Korea, Poland or Sweden. The gender difference in mathematics performance in Northern Ireland (12.0 score points) is similar to Ireland.

Table 3.4. Gender differences on the mathematics scale in Ireland, in selected comparison countries/economies and on average across OECD countries

	Males		Females		Difference (males-females)	
	Mean	SE	Mean	SE	Score diff.	SED
Singapore	580.6	(1.7)	568.5	(1.7)	**12.1**	(2.3)
Korea	529.7	(5.6)	524.6	(3.7)	5.1	(5.6)
Estonia	513.0	(2.2)	506.7	(2.5)	**6.3**	(2.4)
Canada*	503.0	(1.9)	490.7	(1.7)	**12.3**	(1.7)
Ireland*	497.8	(2.7)	485.1	(2.7)	**12.7**	(3.5)
United Kingdom*	496.0	(3.0)	481.7	(2.9)	**14.4**	(3.8)
Poland	491.7	(2.7)	486.2	(2.9)	5.5	(3.3)
New Zealand*	484.2	(2.9)	473.8	(2.6)	**10.4**	(3.8)
Sweden	482.8	(2.7)	480.7	(2.1)	2.2	(2.6)
Finland	481.7	(2.3)	486.7	(2.1)	**-5.1**	(2.3)
Northern Ireland*	481.4	(4.5)	469.3	(3.5)	**12.0**	(5.4)
OECD Average	476.9	(0.5)	467.8	(0.4)	**9.1**	(0.5)
United States*	471.4	(4.7)	458.1	(3.9)	**13.3**	(3.2)

Source: OECD 2023c, Table I.B1.4.17. Table I.B2.30 is the source of NI data.
Significant differences are in **bold.**
Note: SED refers to the Standard Error of the Difference.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

Though male students in Ireland outperformed females in maths by almost 13 points, there is variance across the distribution of performance. Figure 3.9 presents the percentage of female and male students performing below Level 2 and at or above Level 5 on the overall mathematics scale in Ireland and on average across OECD countries.

In Ireland, a similar percentage of male and female students performed below Level 2 in mathematics (18.5% for males and 19.6% for females). Across OECD countries on average 30.6% of males and 31.6% of females performed below Level 2.

Looking at students performing at or above Level 5, in Ireland a significantly higher percentage of male students performed at or above Level 5 (9.6%) compared to females (4.7%). Across OECD countries, a similar pattern emerged with a significantly higher percentage of male students (10.5%) achieving proficiency Levels 5 and 6 than females (6.8%).

Figure 3.9. Percentages of male and female students achieving below Proficiency Level 2 and at or above Proficiency Level 5 on the mathematics scale, in Ireland and on average across OECD countries

Source: OECD 2023c, Table I.B1.4.31.

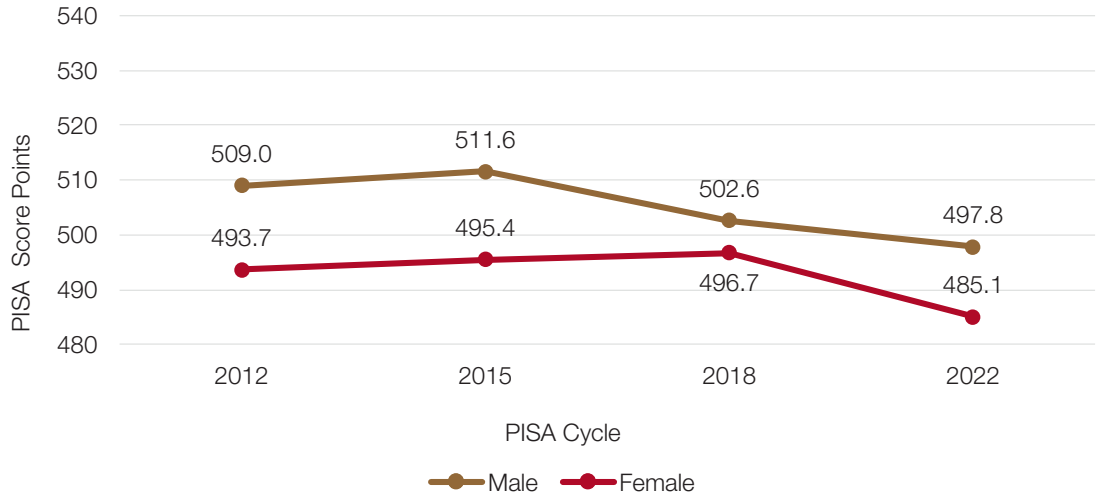
3.5.2 Trends in mathematics performance by gender

This section examines trends in performance by gender. As with all trend analysis for Ireland, differences between PISA cycles should be interpreted with consideration of the known bias in the 2022 estimates. This section compares 2022 results with 2018 data for short-term trends, and 2012 results (when mathematics was last the main domain) for longer-term analysis.

The overall mathematics mean score for female students in Ireland has decreased by 11.6 points since the 2018 cycle. This decrease is statistically significant. Female students achieved a mean score of 493.7 in 2012, 496.7 in 2018, and 485.1 in 2022. However, when comparing the 2022 mean score with that from 2012, the decrease (8.6 score points) is not statistically significant. Across the three cycles, the mean score for female students in Ireland was also consistently higher in Ireland than for females on average across OECD and this continues to be the case in 2022.

Consistent with other PISA cycles in Ireland, male students continued to achieve higher mean scores than females in mathematics in 2022, although, while the gender difference was not statistically significant in 2018 (5.9 points), it is in 2022 (12.7 points) (OECD 2023c, Table I.B1.5.40). A decrease in the mean score of male students is also evident when compared to 2018. In 2012, the mean achievement for males in Ireland was 509.0, falling to 502.6 in 2018, and 497.8 in 2022. When comparing the 2022 and 2012 means for males, the difference (11.2 score points) is statistically significant. Compared to 2018, however, the 4.8 score point decrease is not statistically significant. Similar to female students in Ireland, males had consistently higher scores than males did on average across OECD countries. At the OECD average, the decline in performance between 2018 and 2022 was 13.0 score points for males and 16.7 score points for females. Both differences are statistically significant.

Figure 3.10. Mean scores of male and female students on overall mathematics in Ireland, 2012 to 2022



Source: OECD 2023c, Tables I.B1.5.38 and I.B1.5.39.

Gender differences in achievement can also be reviewed across cycles with reference to proficiency levels. Table 3.5 describes the percentages of males and females below Level 2, and at or above Level 5 in Ireland across three PISA cycles: 2012, 2018 and 2022.

The proportion of male students in Ireland performing below Level 2 was relatively stable between the 2012 cycle (15.2%) and the 2018 cycle (15.7%), with an increase of just 0.5 percentage points in this category. This percentage increased in 2022, however, to 18.5%, though it should be noted that this increase (relative to both the 2012 and 2018 cycles) is not statistically significant.

For female students, there was a decrease in the percentage of female students performing below Level 2 between 2012 (18.7%) and 2018 (15.7%). However, this pattern did not continue as 2022 saw an increase in this category to 19.6% of female students performing below Level 2. When comparing the difference between the 2022 and 2012 cycles, the difference is not statistically significant. However, the 3.9 percentage point difference between the 2022 and 2018 cycles is significant.

Looking at male students performing at or above Level 5 across cycles, we see that the proportion of males in Ireland at this level decreased between 2012 (when it was 12.7%) to 2018 (9.9%), but remained relatively stable between 2018 and 2022 (when it reached 9.6%). When comparing the 2022 percentages with those of the 2012 cycle, the difference is statistically significant, while the small change between 2018 and 2022 is not significant.

A decrease in the percentage of females performing at or above Level 5 in mathematics is also evident between the 2012 and 2018 cycles (8.5% and 6.6%, respectively), and a further decrease is evident in the 2022 cycle where 4.7% of female students now perform at this level. The 3.8 percentage point difference between the 2022 cycle and the 2012 cycle is statistically significant, while the difference between 2018 and 2022 is not.

Table 3.5. Percentage of male and female students below Proficiency Level 2 and at or above Proficiency Level 5 on mathematics in Ireland, 2012, 2018, 2022

	Below Level 2				At or above Level 5			
	Male		Female		Male		Female	
	%	SE	%	SE	%	SE	%	SE
2012	15.2	(1.4)	18.7	(1.2)	12.7	(0.9)	8.5	(0.7)
2018	15.7	(1.1)	15.7	(1.1)	9.9	(0.9)	6.6	(0.8)
2022	18.5	(1.2)	19.6	(1.3)	9.6	(0.8)	4.7	(0.6)
	Diff	**SED**	**Diff**	**SED**	**Diff**	**SED**	**Diff**	**SED**
2022-2012	3.3	(2.1)	0.9	(2.1)	**-3.1**	(1.3)	**-3.8**	(1.0)
2022-2018	2.9	(1.7)	**3.9**	(1.8)	-0.3	(1.3)	-1.8	(1.0)

Source: OECD 2023c, Tables I.B1.5.47 and I.B1.5.49. Significant differences are in **bold**.

3.5.3 Mathematics performance by students' Economic, Social and Cultural Status (ESCS)

PISA measures students' Economic, Social and Cultural Status (ESCS) using an index based on variables including parental occupation, highest level of parental education, and home possessions, which is used as a proxy for family wealth. This index has a mean of zero and a standard deviation of one across all participating OECD countries. On average, students in Ireland reported having a considerably higher ESCS than their counterparts across OECD countries (0.33 compared to 0.00). Furthermore, in Ireland, 13.0% of the variance in mathematics performance is explained by ESCS and a one-unit (i.e., one standard deviation) increase in ESCS is associated with an increase of 35.5 points on the mathematics scale, compared to 15.5% and 39.4 points, respectively, at the OECD average (OECD, 2023c), indicating that the relationship between ESCS and performance is slightly weaker in Ireland than on average across OECD countries.

When the ESCS index is divided into quartiles, significant differences in mean scores are found between students in the lowest category and those in all other quartiles (Table 3.6). There is a difference of 73.7 score points between students in the top and bottom ESCS quartiles in Ireland, compared to 93.5 points at the OECD average, indicating larger performance differences between the most and least advantaged students on average across the OECD than in Ireland.

Table 3.6. Mean scores on mathematics by ESCS quartile, in Ireland

Quartiles of ESCS	%	Mean	SE	SD
Lowest *(ref. group)*	25.0	456.7	(3.2)	75.7
Low-Medium ESCS	25.0	**478.3**	(3.0)	72.8
Medium-High ESCS	25.0	**504.5**	(2.7)	71.7
Highest	25.0	**530.5**	(3.0)	76.5

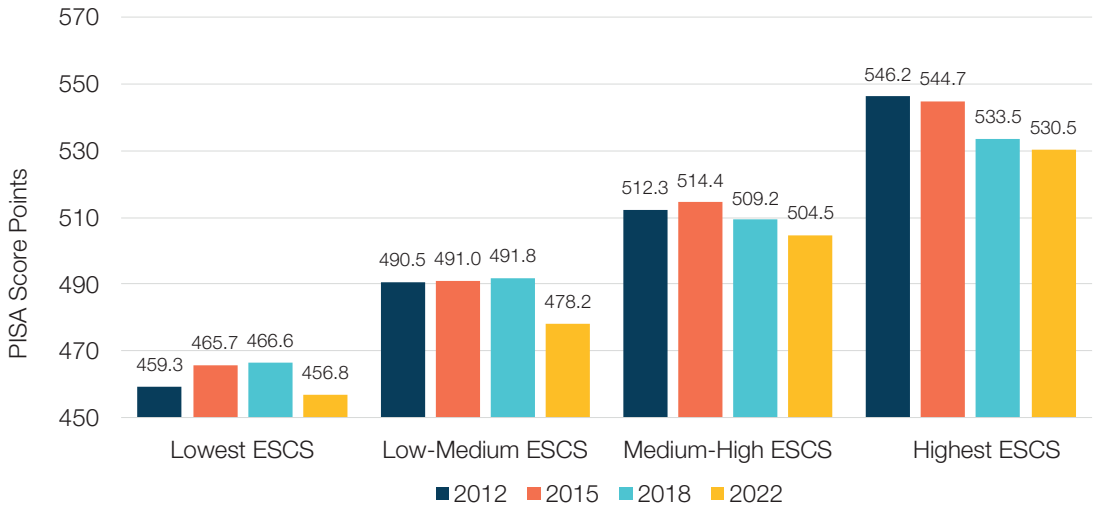
Source: OECD 2023c, Table I.B1.4.3. Significantly, different mean scores are in **bold** (compared with the reference group).

Figure 3.11 presents the mathematics scores of students at each of the ESCS quartiles across the last four PISA cycles. The mathematics performance of students in the bottom two quartiles of the ESCS scale (i.e., those experiencing more socioeconomic disadvantage) declined significantly between 2018 and 2022 (by 9.7 points for those with the lowest ESCS and 13.6 points for those with low-medium ESCS), while little change is observed in the performance of students in the top two

quartiles (with non-significant declines of 4.7 points for those with medium-high ESCS and 3.0 points for those with the highest ESCS).

However, when comparing the mathematics performance of students across the ESCS scale over the longer term, significant declines are observed among those in the highest ESCS category (-15.7 points) and those with low-medium ESCS (-12.3 points) between 2012 and 2022. When short-term and long-term trends are considered, this indicates that mathematics performance improved among the most disadvantaged students in Ireland between 2012 and 2018, but has, in 2022, returned to about the same level as in 2012, while performance among the most advantaged students declined between 2012 and 2018, but remained relatively stable between 2018 and 2022. On average across OECD countries, declines in mathematics performance are observed across all ESCS quartile groups, of between 10 and 17 points, since 2018.

Figure 3.11. Mathematics performance by ESCS quartile, in Ireland from 2012 to 2022



Source: OECD 2023c, Table I.B1.5.19

3.5.4 Student immigration status and mathematics performance

The PISA 2022 international report gives prominence to the educational outcomes of students with an immigrant background. The international results show that non-immigrant students tend to outperform immigrant students in all PISA subjects in most (but not all) countries. However, this gap in performance is mainly attributable to socio-economic differences and the linguistic barriers that commonly face immigrant students.

In Ireland, 17.4% of students have an immigrant background, compared to 12.9% on average across OECD countries. Eight percent of students in Ireland are first-generation immigrant students,[32] while 9.4% are second-generation students (Table 3.7).[33]

[32] First-generation students are those born outside Ireland and whose parents were also born in another country.

[33] Second-generation students are those who were born in Ireland but whose parent or parents were born in another country.

Table 3.7. Students' mean mathematics performance by immigration status, in Ireland and on average across OECD countries

	Non-immigrant students		First-generation immigrant students		Second-generation immigrant students		Difference (Non-immigrant – Immigrant)*	
	%	Mean (SE)	%	Mean (SE)	%	Mean (SE)	Score diff.	SED
OECD average	87.1	478.7 (0.4)	5.4	434.9 (1.6)	7.6	458.6 (1.3)	**-29.8**	1.2
Ireland*	82.6	494.8 (2.2)	8.0	484.1 (4.0)	9.4	488.7 (4.3)	**-8.2**	3.4

Source: Adapted from OECD 2023c, Tables I.B1.7.1 and I.B1.7.17. Significant differences are in **bold**.
* This is the difference between the mean score of non-immigrant students and the combined mean of first and second generation immigrants.

Table 3.8 describes students' ESCS status by immigrant status on average across the OECD and in Ireland. Immigrant students in Ireland reported significantly lower ESCS than non-immigrant students, though the difference in ESCS between immigrant and non-immigrant students is narrower in Ireland (-0.22 scale points) than on average across OECD countries (-0.38 scale points). A significantly greater percentage of immigrant students in Ireland are reported to be socioeconomically disadvantaged[34] than non-immigrant students (30.2% and 24.0%, respectively), while a significantly greater percentage of non-immigrant students are classified as socioeconomically advantaged students.[35] At the OECD average, similar patterns can be observed, although the percentage of immigrant students classified as socioeconomically disadvantaged is larger on average across OECD countries than in Ireland (by 8.8 percentage points).

[34] Socioeconomically disadvantaged means that these students lie within the bottom quartile of the ESCS scale.

[35] Socioeconomically advantaged means that these students lie within the top quartile of the ESCS scale.

Table 3.8. Students' ESCS status by immigration status, in Ireland and on average across OECD countries

	Student ESCS					
	Non-immigrant		Immigrant		Difference immigrant and non-immigrant	
	Mean Index	S.E	Mean Index	S.E	Dif.	S.E
OECD Average	0.1	(0.0)	-0.3	(0.1)	**-0.4**	(0.0)
Ireland	0.4	(0.0)	0.2	(0.0)	**-0.2**	(0.0)
	Percentage of disadvantaged students					
	Non-immigrant		Immigrant		Difference immigrant and non-immigrant	
	%	S.E	%	S.E	Dif.	S.E
OECD Average	22.2	(0.1)	37.1	(0.5)	**15.0**	(0.5)
Ireland	24.0	(1.4)	30.2	(1.7)	**6.2**	(1.8)
	Percentage of advantaged students					
	Non-immigrant		Immigrant		Difference immigrant and non-immigrant	
	%	S.E	%	S.E	Dif.	S.E
OECD Average	26.9	(0.2)	16.3	(0.5)	**-10.7**	(0.5)
Ireland	27.1	(1.1)	15.7	(1.6)	**-11.4**	(1.6)

Source: Adapted from OECD 2023c, Table I.B1.7.5. Significant differences are in **bold**.

Table 3.9 describes the percentages of students speaking languages at home other than the one they took the PISA assessment in. In Ireland, 11.1% of students report speaking mainly a language other than the test language (i.e., English or Irish in Ireland) at home. This is similar to the OECD average of 11.2%. In Ireland, a higher percentage of first-generation immigrant students report speaking predominantly another language at home (71.4%), while 47.8% of second-generation immigrant students do so. Non-immigrant students tend to speak English or Irish, with only 0.8% of these students speaking another language at home.

Table 3.9. Percentage of students who speak mainly another language at home, in Ireland and on average across OECD countries

	All students		Non-immigrant students		First-Generation immigrant students		Second-Generation immigrant students	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.
OECD average	11.2	(0.1)	4.2	(0.1)	61.9	(0.6)	43.8	(0.6)
Ireland	11.1	(0.9)	0.8	(0.1)	71.4	(3.1)	47.8	(2.6)

Source: Adapted from OECD 2023c, Table I.B1.7.9.

Earlier in this section, in Table 3.7, we saw that on average, immigrant students in Ireland performed significantly less well in mathematics than non-immigrant students (a difference of 8.2 points). However, the difference in mathematics performance between immigrant and non-immigrant students in Ireland (8.2 points) almost completely disappears (to 0.2 points) when students' socioeconomic status and language spoken at home are accounted for (OECD 2023d, Table I.B1.7.53).

3.5.5 Mathematics performance by school sector and gender composition

Schools in Ireland are categorised into five types based on their sector and gender composition: girls' secondary, boys' secondary, mixed secondary, community and comprehensive, and ETB vocational schools. Students attending boys' secondary schools achieved the highest mean mathematics score (513.0), which is significantly higher than the mean score achieved by students in ETB vocational schools (483.8). On the other hand, the performance of students in ETB schools did not differ significantly from that of students in community/comprehensive, or girls' and mixed secondary schools (Table 3.10). Similarly, no significant difference in mean mathematics performance was found between students in ETB vocational schools and community/comprehensive schools.

Table 3.10. Mean scores on mathematics by school type and gender composition, in Ireland

School type	%	Mean	SE	SD
Girls' secondary	17.8	493.1	5.9	74.8
Boys' secondary	16.5	**513.0**	5.7	82.4
Mixed secondary	19.1	491.6	4.0	77.3
Community/comprehensive*	16.2	483.1	5.3	80.2
ETB vocational *(ref. group)*	30.4	483.8	2.7	79.7

Significantly different mean scores are in **bold** (in comparison to the reference group).
*The vast majority of community/comprehensive and ETB schools have a mixed gender composition. As the number of single-sex community/comprehensive and ETB schools is very small, they are not considered as separate categories in this analysis.

3.5.6 Mathematics performance by DEIS status

In Ireland, approximately one-fifth of PISA students attended DEIS schools and these students achieved a significantly lower mean score on mathematics than their peers in non-DEIS schools, by 35.6 points (Table 3.11). However, as noted in Chapter 1, there was a large decrease in the student response rate in Ireland between 2018 and 2022 (from 86% to 77%) and the Non-Response Bias Analysis (NRBA) for Ireland, indicated an upward bias in Ireland's estimates for 2022. Furthermore, it was noted that the bias is likely to be larger for students in DEIS schools than those in non-DEIS schools. This means that the difference observed between students in DEIS and non-DEIS schools in 2022 is likely to be an underestimate. Furthermore, the DEIS programme was extended in 2022 to include an additional 38 post-primary schools, meaning that two DEIS schools in the PISA 2022 sample were not classified as DEIS schools in 2018. Therefore, a high degree of caution is required when interpreting the PISA findings by DEIS status in 2022 and when making comparisons by these subgroups with previous cycles.

Table 3.11. Mean scores on mathematics by DEIS status, in Ireland

DEIS Status	%	Mean	SE	SD
DEIS	21.0	**463.5**	(3.9)	78.4
Non-DEIS *(ref. group)*	79.0	499.1	(2.1)	78.3

Significantly different mean scores are in **bold** (compared with the reference group).

3.6 Summary

This chapter described Ireland's performance in mathematics in PISA 2022 in detail, with mathematics as the major assessment domain. The mathematics framework underwent considerable revision, and the definition of mathematical literacy was updated. The new framework needed to reflect the societal and educational changes that have taken place since the framework was last redrawn in 2012, placing an emphasis on the impact technological changes have had on the teaching and learning of mathematics, as well as its use in everyday life. The new framework posits reasoning as an increasingly important key skill, central to mathematical thinking. By using proper reasoning, the framework proposes that students can arrive at results that can be relied upon in real-life contexts. The framework outlines four process areas (reasoning, formulating, employing, and interpreting) and four content areas (change & relationships, quantity, space & shape, and uncertainty & data) which are reported on in this chapter.

Ireland's mean mathematics achievement in PISA 2022 is 491.6, which is significantly higher than the OECD average of 472.4, and significantly higher than the mean scores of 63 PISA-participating countries/economies. Nine economies achieved a mean mathematics score that is significantly higher than Ireland's (Singapore, Macao, Chinese Taipei, Hong Kong, Japan, Korea, Estonia, Switzerland, and Canada), while Ireland's mean mathematics performance does not differ from that of eight economies (Netherlands, Belgium, Denmark, United Kingdom, Poland, Austria, Australia, and Czech Republic). The mean mathematics score for Northern Ireland is 475.1, which is significantly lower than Ireland's mean achievement. When compared to previous cycles, Ireland has seen a significant decrease of 8.0 points in mathematics since 2018, and 9.8 PISA score points since 2012. A significant decrease is also observed at the international level, with the OECD average in 2022 dropping by 15.7 points when compared to 2012, and 14.8 points when compared to 2018.

Applying a 95% confidence interval, which takes account of measurement and sampling error, Ireland's mean mathematics score falls between 487.7 and 495.6 (with the reported mean of 491.6, being the midpoint in this range). When this range is considered, Ireland's mean mathematics performance is placed between 5th and 18th place among OECD countries, and between 9th and 22nd place among all participating economies.

Students in Ireland performed above the OECD average on all four cognitive process subscales (formulating, employing, interpreting, and reasoning), though performance on the formulating and reasoning subscales was somewhat weaker than performance on the remaining subscales. Students in Ireland also outperformed OECD students on average on the mathematical subscales of uncertainty & data, change & relationships, and quantity. However, performance in Ireland on the space & shape subscale was notably much closer to the OECD average than for the other content subscales, indicating an area of relative difficulty for students in Ireland.

In this cycle of PISA, eight proficiency levels are reported on for mathematics, with students performing below Level 2 considered to be lower performers, and those at or above Level 5 considered to be higher achievers. Ireland has fewer students performing below Level 2 (19.0%) than on average across OECD countries (31.1%). Of the selected comparison countries, only three countries have fewer students than Ireland performing below Level 2 (Korea with 16.2%, Estonia with 15.0% and Singapore with 8.0% of students). The percentage of top performers in mathematics in Ireland (7.2%) is lower than the OECD average of 8.7% and lower than the corresponding percentages in each of the selected comparison countries, indicating relative underperformance among the highest-achieving students in mathematics in Ireland.

In 2022, 19% of students in Ireland performed below proficiency Level 2, which is significantly higher than 2018, when 15.7% of students in Ireland were recorded at this level, and 16.9% in 2012 when mathematics was last the main domain (though this difference is not statistically significant). Instead, in 2022, 7.2% of students in Ireland performed above Level 5. This was not significantly lower than in 2018 (8.2%), but is significantly different from 10.7% in 2012. These observed increases in the percentages of students below Level 2 and decreases in the percentages of students at or above Level 5, when compared to previous cycles are similar to the patterns observed at OECD level.

Male students significantly outperformed female students on PISA overall mathematics. The gender difference (12.7 score points in favour of males) is significantly different, and is larger than the OECD average difference (9.1 points). Internationally, the picture in terms of gender is mixed, with three of the selected comparator countries showing non-significant differences between the genders, while Finland had a statistically significant difference of 5.1 score points in favour of female students. Just two comparison countries had a slightly larger gender difference than Ireland in favour of males, United Kingdom (14.4 points), United States (13.3). Though male students in Ireland outperformed females in mathematics by almost 13 points, there is variance across the distribution of performance. While a similar percentage of males and females performed below Level 2 in mathematics (18.5% for male students and 19.6% for female students), a significantly higher percentage of males performed at or above Level 5 (9.6%) compared to females (4.7%). These differences in the gender distribution across the proficiency levels were also reflected at OECD level, albeit with different gaps (30.6% of males and 31.6% of females performed below Level 2 and 10.5% of males and 6.8% of females above Level 5 at OECD level).

In line with the patterns from previous PISA cycles, male students in Ireland continue to outperform female students in mathematics, and the difference is statistically significant in 2022. Male students in 2022 achieved a mean score that was not statistically different from 2018, but a significant decrease of 11.2 points can be seen between 2012 and 2022. Female students' achievement decreased by 8.6 between 2012 and 2022, but this difference is not statistically significant. However, the difference between the 2018 and 2022 cycles, of 11.6 points, is significant. At OECD level, the change in performance for males between 2018 and 2022 was -13.0 points for males and -16.7 points for females. Both differences are statistically significant.

Overall, students in Ireland reported having a considerably higher Economic, Social and Cultural Status (ESCS), a proxy measure for socioeconomic status, than their counterparts across OECD countries (0.33 compared to 0.00). Compared to the most socioeconomically disadvantaged students, all other students had significantly higher mathematics mean scores. There is a difference of 73.7 score points between the most and least advantaged students in Ireland, compared to 93.5 points at the OECD average. This indicates smaller performance differences between the most and least advantaged students in Ireland than across the OECD.

Students with an immigrant background account for 17.4% of students in Ireland, compared to 12.9% on average across OECD countries. In Ireland, 11.1% of students reported speaking mostly a language other than the test language (i.e., English or Irish in Ireland) at home, which is similar to the OECD average of 11.2%. This is mostly composed of immigrant students. Immigrant students in Ireland reported significantly lower ESCS than non-immigrant students, though the difference in ESCS between immigrant and non-immigrant students is narrower in Ireland (-0.2 scale points) than on average across OECD countries (-0.4 scale points). On average, immigrant students in Ireland performed significantly less well in mathematics than non-immigrant students (a difference of 8.2 points). However, the difference in mathematics performance between immigrant and non-immigrant

students in Ireland almost completely disappears when students' socioeconomic status and language spoken at home are accounted for.

Students attending boys' secondary schools achieved the highest mean mathematics score (513.0), which is significantly higher than the mean score achieved by students in ETB vocational schools (483.8). Students attending DEIS schools had mean scores that were significantly lower (-35.6 points) than those of students attending non-DEIS schools.

Chapter 4: Performance on Reading

Key Findings

- **Ireland's mean score of 516.0 on the reading scale is significantly higher than the OECD average of 475.6.**
- **Just one country performed at a significantly higher level than Ireland in reading (Singapore), while four countries obtained mean scores that do not differ significantly from Ireland's.**
- **Just over one-in-ten students in Ireland performed at the highest reading proficiency levels, and 11.4% of students in Ireland performed at the lowest levels of proficiency. Overall, Ireland has fewer students with below baseline proficiency, and more students with higher achievement than on average across the OECD.**
- **In Ireland, female students achieved higher scores on the reading literacy scale (525.4), significantly outperforming male students (507.1) by 18.3 score points.**
- **Ireland's mean score on the reading literacy scale was 2.1 points lower than in 2018 (518.1), when reading literacy was last a major domain in the PISA study, but this difference was not statistically significant.**
- **Students in Ireland who experience the greatest levels of socioeconomic disadvantage achieved a mean reading score that is significantly lower than the mean scores of all other students, and is 75.6 points lower than the most advantaged students (479.0 compared to 554.6).**

This chapter is organised into five sections:

- A description of the framework underpinning PISA reading literacy in 2022;
- A description of overall student performance on reading literacy, with reference to mean scores in Ireland and in other participating countries, and across PISA cycles;
- A description of the reading literacy proficiency levels, and analysis of the proportion of students achieving each reading literacy proficiency level in Ireland and internationally;
- An analysis of selected variables associated with achievement including gender; immigrant and socioeconomic status; school sector and gender-composition; and DEIS status; in 2022 and across PISA cycles;
- A summary of the key findings.

Ireland's weighted student-level response in PISA 2022 (76.8%) fell below the minimum 80% threshold outlined by the PISA Technical Standards, meaning that a Non-Response Bias Analysis (NRBA) of Ireland's data was required. This analysis indicated that there was an upward bias of approximately one-tenth of a standard deviation in the achievement estimates for Ireland in 2022, meaning estimates presented in this chapter are likely to be somewhat of an overestimation of Ireland's 'true' performance if all selected students had taken part. Therefore, the figures presented

in this chapter should be interpreted with consideration of the results of the NRBA and particular caution should be applied when comparisons are made with the findings from previous cycles.

4.1 Framework for Reading Literacy

Reading literacy was assessed as a minor domain in PISA 2022, having previously been a major domain in PISA in 2018, 2009, and 2000. As a minor domain, reading received less assessment time than mathematics (the major domain), and reading literacy subscales were not analysed or reported.

Since the first cycle of PISA in 2000, the reading literacy framework has twice undergone significant revisions (in 2009 and 2018). These revisions reflect changing definitions and theories of reading literacy, as well as the varied contexts in which students encounter complex text-based materials (OECD, 2019a). The PISA 2022 reading literacy assessment framework is identical to that used in 2018.

4.1.1 Definition of reading literacy

Reading literacy, as assessed in PISA 2022, is defined as

> understanding, using, evaluating, reflecting on and engaging with texts in order to achieve one's goals, to develop one's knowledge and potential and to participate in society (OECD, 2019a, p.28).

This definition encompasses key reading processes (understanding, using, evaluating, reflecting on and engaging with texts) and purposes (achieving goals, developing knowledge and potential and participation in society).

The framework uses the term 'reading literacy' rather than 'reading' to emphasise the breadth of the cognitive and linguistic competencies that PISA aims to measure: '... from basic decoding to knowledge of words, grammar and the larger linguistic and textual structures needed for comprehension, as well as integration of meaning with one's knowledge about the world' (OECD, 2019a, p.28). The framework also refers to metacognitive competencies, which relate to students' ability to reflect on their reading and use appropriate strategies to process a text and achieve a specific goal.

The definition of reading literacy has evolved through past cycles; most recently, in 2018, evaluation of texts was included as a key component and the word 'written' was removed as a descriptor of texts. The addition of 'evaluating' to the definition underlines that reading is often goal-oriented and therefore readers must assess the validity of the arguments in a text, the author's perspective and the relevance of the text to their reading goal. The removal of the word 'written' reflects a broader understanding of texts as 'all language as used in its graphic form' (OECD, 2019a, p.29), including handwriting, printed or digital text, and visual displays like diagrams, maps, tables, graphs and comic strips. The societal shift from paper to digital texts is emphasised in the framework, 'to achieve a more authentic assessment of reading consistent with the current use of texts around the world' (OECD, 2019a, p.25).

4.1.2 Reading literacy processes and assessment design

The reading literacy assessment is created around three main characteristics: texts (the reading materials that make up the test content), processes (the cognitive aspects of a reader's engagement with a text) and scenarios (the various contexts and purposes of reading). Within each scenario, the reader encounters different tasks, and the difficulty of these tasks can vary. This is achieved by manipulating both features of the text and the goal of the task set for the reader, which requires them then to call on different cognitive processes. Each reader will have different skills and background factors (including reading strategies and motivation) and these reader factors were measured in the 2018 questionnaires (OECD, 2019a, p.31).

The reading literacy framework describes four dimensions of texts along which test design can vary, thereby allowing a broad coverage of the domain, as well as a balance of traditional and newer reading practices:

- **Text source** can be single (having a defined author[s], publication date or reference title/number) or multiple (defined by having different authors, different publication dates or different titles).
- **Organisational and navigational structure** relates to the arrangement of the text on the screen, and the types of navigational devices that are required to interact with it (e.g., scrolling, clicking through tabs, menus, tables of contents and hyperlinks). This structure may be static (e.g., one or more screen pages in a linear arrangement with few navigational tools) or dynamic (e.g. a non-linear, complex structure with a greater density of navigational tools).
- **Text format**, which can be continuous, non-continuous or mixed. Continuous texts are formed from sentences and paragraphs (e.g., essays, novels, short stories, reviews, letters), while non-continuous texts typically consist of one or more lists (e.g., schedules, catalogues, forms, tables, graphs, diagrams, advertisements). Mixed texts contain several elements in both continuous and non-continuous formats (e.g., a graph with an explanatory legend or a diagram with a paragraph) (OECD, 2019a, p.31).
- **Text type** includes six categories, although it is noted that many texts may belong to more than one category. The six categories are adapted from the work of Werlich (1976 in OECD, 2019a, p. 46):
  - description (e.g., depiction of a particular place in a travelogue, a geographical map or a description of a process in a technical manual)
  - narration (e.g., novels, short stories, newspaper reports)
  - exposition (e.g., scholarly essays, diagram of how a biological system functions, graphs of population trends)
  - argumentation (e.g., letters to the editor, advertisements, online forum posts)
  - instruction (recipes, diagrams depicting a first-aid procedure, guidelines for operating digital software)
  - transaction (e.g., everyday email and text message exchanges that arrange or confirm plans).

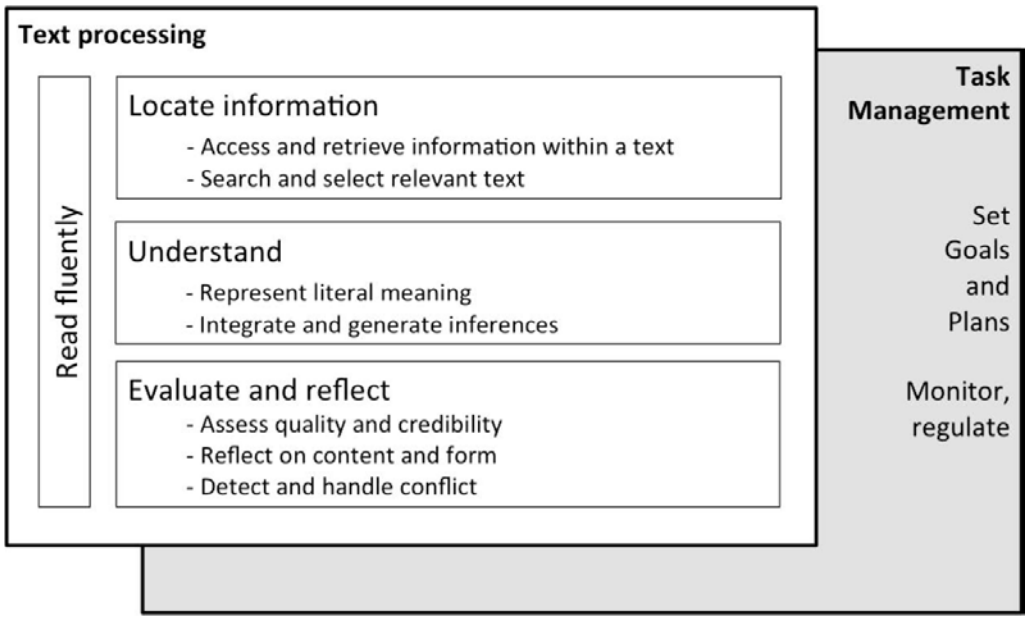
The cognitive processes assessed in PISA were revised in the 2018 reading literacy framework for three reasons: (i) to reflect the increasingly diverse and complex literacy demands of school and society, which are partly influenced by the evolution of technology and spread of Internet access;

(ii) to take into account recent developments in reading literacy research and theory and to ensure that the most up to date terminology is used; (iii) to reassess the balance between ensuring fidelity to every aspect of the framework, and the feasibility of accounting for each of these aspects in an international large-scale assessment.

The reading framework processes are outlined in Figure 4.1, and are divided into two broad categories: text processing and task management. The main focus of the cognitive assessment in PISA is on text processing, which involves locating information, understanding, evaluating and reflecting. Task management involves setting goals and plans, monitoring and regulating. Students must utilise these metacognitive processes in their interactions with the test.

Reading fluently is included as an element of text processing, and is defined as 'the ease and efficiency of reading texts for understanding' (OECD, 2019a, p.33). Reading fluency is assessed because it can assist in describing and understanding between-student differences, particularly among students with the lowest levels of reading proficiency. Students with low levels of reading fluency may struggle with higher-level comprehension tasks. This is because they expend significant effort on lower-level reading skills (e.g., word recognition, decoding) which can deplete their cognitive resources and make higher-level tasks more difficult (Rasinski et al., 2005).

Figure 4.1. PISA 2022 reading framework processes



Source: OECD, 2019a, p.33.

The concepts outlined in the framework are represented in tasks that assess students' proficiency in reading literacy. Each task primarily assesses one of the three categories of reading literacy process outlined above (locate information, understand, evaluate & reflect).

Some tasks in PISA are standalone texts with associated questions, known as units. Since 2018, the reading literacy assessment has also incorporated a scenario-based approach, which involves students interacting with a collection of thematically-related texts in order to perform a higher-level task (OECD, 2019a). These aim to offer more true-to-life reading situations than the unit-based approach. The framework classifies reading situations as follows:

- **Personal** – in which the reader reads for their own personal interests, whether practical, intellectual or recreational. Such texts include personal letters, fiction, biography and informational texts. Digital texts pertaining to personal reading situations include emails, instant messages and diary-style blogs.
- **Public** – in which texts are related to broader societal activities and issues. These may include official documents and information about public events, e.g., message boards, websites and public notices, whether online or in print.
- **Educational** – in which texts have an instructional function and the purpose of reading is to acquire information. This category may include printed/electronic textbooks or interactive learning software.
- **Occupational** – in which texts typically include job advertisements or workplace directions. These texts are intended to address PISA's goal of assessing students' application of reading literacy skills to real-life situations that they will encounter after finishing school.

A Multistage Adaptive Testing (MSAT) design was first successfully implemented in PISA 2018, when reading literacy was the main domain. In such a design, a student's path through the assessment is determined by both random numbers and their performance. The PISA 2022 reading literacy assessment uses the same adaptive structure (i.e., the same number of stages and adaptation levels) as 2018 and the same item pool, reduced by approximately 25% (OECD 2023 in press, Table 3.1).

4.1.3 Item types and distribution of reading literacy items by framework components

Table 4.1 presents the distribution of reading items by process, text format, situations and text type in PISA 2022. For single and multiple text processes, the percentages of items in the assessment are compared with the percentages that were originally proposed in the assessment framework. The item pool for the PISA 2022 reading assessment consisted of 197 items in total.

Table 4.1. Distribution of PISA 2022 reading items by process, text format, situations and text type, compared with distribution recommended in PISA reading literacy framework

Component	Number	%	Framework recommendation	Component	Number	%
Single text processes				**Situations**		
Scan and locate	21	11%	15%	Educational	43	22%
Represent literal meaning	41	21%	15%	Multiple	5	3%
Integrate and generate inferences	48	24%	15%	Occupational	22	11%
Assess quality and credibility	38	19%	20%	Personal	35	18%
Reflect on content and form				Public	92	46%
Total	148	75%	65%	Total	197	100%
Multiple text processes				**Text type**		
Search and select relevant text	19	10%	10%	Argumentative	35	18%
Integrate and generate inferences (MS)	14	7%	15%	Description	26	13%
Corroborate and handle conflict	16	8%	10%	Exposition	59	30%
Total	49	25%	35%	Instruction	9	5%
				Interaction	0	0%
Text format				Multiple	19	10%
Continuous	123	62%	-	Narrative	24	12%
Non-continuous	19	10%	-	Transactional	25	12%
Mixed	55	28%	-	Total	197	
Total	197	100%				
Text structure				**Item format**		
Single	66	34%		Complex multiple choice - Computer coded	27	14%
Multiple	131	66%		Simple multiple choice - Computer coded	104	53%
Total	197	100%		Open response - Human coded	64	32%
				Open response - Computer coded	2	1%
				Total	197	100%

Adapted from: ETS 2021, and Table 3.2, OECD, in press.
Note: This table includes information from the recommended Main Study item pool for 2022. The PISA reading framework did not include a recommended distribution for situations, text formats and text types.

While the PISA reading literacy assessment includes 66 open-ended responses (33% of all reading items in PISA 2022) that require students to type their answer, PISA does not assess the spelling and quality of writing in scoring responses. Examples of PISA reading literacy assessment items can be found in the PISA 2018 report (McKeown et al., 2019) or at https://www.oecd.org/pisa/test/.

4.2 Overall Performance on Reading Literacy

This section examines the mean reading literacy performance of students in Ireland in PISA 2022, firstly in relation to all countries/economies that participated. Subsequently, the performance of students in Ireland is analysed across recent PISA cycles and compared to trends across OECD countries on average.

Ireland's mean reading literacy score is 516.0, which exceeds the OECD average by 40 points. One country, Singapore, achieved a significantly higher mean reading score than Ireland and four economies (Japan, Korea, Chinese Taipei, and Estonia) obtained mean scores that do not differ significantly from Ireland's. Seventy-five countries and economies had mean scores that are significantly lower than Ireland's. The mean reading score for Northern Ireland is 485.2 (SE = 3.4, SD = 100.2 see E-Appendix Table 4.1). This is not significantly different from the mean score for Ireland, or the OECD average (OECD 2023c, Table I.B2.2).

When measurement and sampling error are taken into account, it is possible to state with 95% confidence that Ireland's score falls within the range of 511.4 to 520.6. Based on this score range, Ireland's mean reading performance places between 2nd and 9th among all countries/economies participating in PISA 2022, and between 1st and 6th among OECD countries.

Ireland's standard deviation for reading is 88.2, while the OECD average standard deviation is 100.5. This indicates that the spread of reading achievement is narrower in Ireland than on average across OECD countries.

Table 4.2: Mean scores, standard deviations (SD) and standard errors (SE) for all countries/ economies, the OECD average and the EU average on the overall reading scale, and positions relative to OECD average and mean score for Ireland

	Mean	SE	SD	SE	IRL
Singapore	542.6	(1.9)	105.9	(1.2)	▲
Ireland*	516.0	(2.3)	88.2	(1.2)	
Japan	515.9	(3.2)	96.3	(1.9)	O
Korea	515.4	(3.6)	103.3	(2.5)	O
Chinese Taipei	515.2	(3.3)	104.6	(2.2)	O
Estonia	511.0	(2.4)	92.5	(1.1)	O
Macao (China)	510.4	(1.3)	89.5	(1.0)	▼
Canada*	507.1	(2.0)	108.7	(1.4)	▼
United States*	503.9	(4.3)	111.4	(1.9)	▼
New Zealand*	500.9	(2.1)	109.1	(1.4)	▼
*Hong Kong (China)**	499.7	(2.8)	98.8	(1.5)	▼
Australia*	498.1	(2.0)	110.9	(1.2)	▼
United Kingdom*	494.4	(2.4)	104.6	(1.6)	▼
Finland	490.2	(2.3)	104.0	(1.1)	▼
Denmark*	488.8	(2.6)	91.9	(1.3)	▼
Poland	488.7	(2.7)	104.0	(1.9)	▼
Czech Republic	488.6	(2.2)	97.9	(1.4)	▼
Sweden	487.0	(2.5)	110.8	(1.5)	▼
Switzerland	483.3	(2.3)	105.0	(1.5)	▼
Italy	481.6	(2.7)	92.3	(1.3)	▼
Austria	480.4	(2.7)	104.1	(1.4)	▼
Germany	479.8	(3.6)	105.9	(1.5)	▼
Belgium	478.9	(2.5)	104.8	(1.4)	▼
Portugal	476.6	(2.7)	93.5	(1.7)	▼
Norway	476.5	(2.5)	112.4	(1.3)	▼
Croatia	475.5	(2.4)	89.1	(1.6)	▼
Latvia*	474.6	(2.5)	89.7	(1.5)	▼
Spain	474.3	(1.7)	96.7	(1.0)	▼
France	473.9	(3.1)	105.8	(1.4)	▼
Israel	473.8	(3.5)	122.1	(1.6)	▼
Hungary	473.0	(2.8)	101.5	(1.9)	▼
Lithuania	471.8	(2.2)	94.2	(1.5)	▼
Slovenia	468.5	(1.6)	96.5	(1.2)	▼
Viet Nam	461.9	(3.9)	76.9	(2.2)	▼
Netherlands*	459.2	(4.3)	114.9	(2.1)	▼
Türkiye	456.1	(1.9)	86.5	(1.1)	▼
Chile	448.0	(2.6)	93.3	(1.4)	▼
Slovak Republic	446.9	(3.1)	104.7	(1.7)	▼
Malta	445.3	(1.9)	111.3	(1.5)	▼
Serbia	440.4	(2.8)	90.8	(2.0)	▼
Greece	438.4	(2.8)	94.3	(1.3)	▼
Iceland	435.9	(2.1)	103.0	(1.3)	▼

	Mean	SE	SD	SE	IRL
Uruguay	430.4	(2.4)	99.2	(1.7)	▼
Brunei Darussalam	429.2	(1.2)	99.3	(1.1)	▼
Romania	428.5	(4.0)	100.4	(1.7)	▼
Ukrainian regions (18 of 27)	427.5	(3.9)	93.1	(2.0)	▼
Qatar	419.3	(1.4)	105.7	(1.3)	▼
United Arab Emirates	417.3	(1.3)	125.2	(0.7)	▼
Mexico	415.4	(2.9)	84.3	(1.8)	▼
Costa Rica	415.2	(2.7)	86.3	(1.2)	▼
Moldova	410.9	(2.5)	87.1	(1.6)	▼
Brazil	410.4	(2.1)	100.0	(1.4)	▼
*Jamaica**	409.6	(4.2)	97.8	(1.8)	▼
Colombia	408.7	(3.8)	93.2	(1.5)	▼
Peru	408.2	(2.7)	91.1	(1.7)	▼
Montenegro	405.0	(1.3)	89.2	(1.0)	▼
Bulgaria	404.3	(3.4)	107.4	(2.3)	▼
Argentina	400.7	(2.6)	92.3	(1.2)	▼
*Panama**	392.0	(3.4)	93.9	(1.9)	▼
Malaysia	388.1	(2.7)	85.9	(1.6)	▼
Kazakhstan	386.3	(1.7)	81.9	(1.1)	▼
Saudi Arabia	382.6	(2.0)	78.9	(1.1)	▼
Cyprus	381.1	(1.2)	108.0	(1.0)	▼
Thailand	378.7	(2.8)	80.2	(2.0)	▼
Mongolia	378.4	(2.3)	76.6	(1.2)	▼
Guatemala	374.1	(2.4)	73.2	(1.6)	▼
Georgia	373.9	(2.3)	83.3	(1.6)	▼
Paraguay	373.2	(2.4)	83.5	(1.2)	▼
Baku (Azerbaijan)	365.2	(2.5)	84.8	(1.2)	▼
El Salvador	364.9	(2.8)	79.3	(1.7)	▼
Indonesia	358.6	(2.9)	75.8	(1.4)	▼
North Macedonia	358.5	(0.8)	75.5	(0.8)	▼
Albania	358.4	(1.9)	80.1	(1.3)	▼
Dominican Republic	351.3	(2.4)	84.0	(1.6)	▼
Palestinian Authority	349.2	(2.0)	76.5	(1.1)	▼
Philippines	346.5	(3.4)	85.2	(2.2)	▼
Kosovo	342.2	(1.1)	66.7	(0.8)	▼
Jordan	342.2	(2.4)	76.7	(1.4)	▼
Morocco	339.4	(4.0)	75.6	(1.9)	▼
Uzbekistan	335.5	(2.0)	66.2	(1.0)	▼
Cambodia	328.8	(2.1)	56.5	(1.0)	▼
OECD Average	475.6	(0.5)	100.5	(0.3)	
EU Average	468.6	(0.5)	100.2	(0.3)	

	Significantly above OECD average		▲	Significantly higher than Ireland
	At OECD average		O	Not significantly different from Ireland
	Significantly below OECD average		▼	Significantly lower than Ireland

Source: OECD 2023c, Table I.B1.2.2.

OECD countries are in regular font, partner countries/economies are in *italics*.

*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

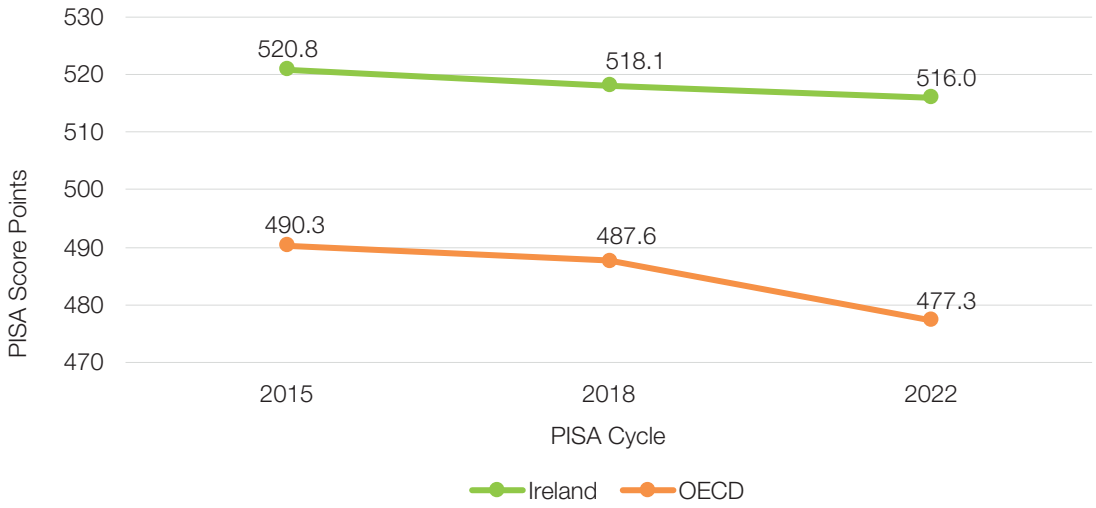
Estimates for United Kingdom include data from Northern Ireland, Scotland, Wales and England. Achievement data for Northern Ireland are described in each chapter and in tabular form in the E-Appendix.

4.2.1 Trends in overall reading literacy performance

The following section elaborates on the description of students in Ireland PISA 2022 reading literacy performance and compares it to the two most recent cycles of PISA (2015 and 2018). PISA 2018 reading literacy data are of particular relevance as this was the most recent PISA cycle when reading literacy was a major domain of the study, and the comparison was extended to PISA 2015 (when reading was a minor domain) in order to present a longer term trend and to give an overview of reading results since PISA moved towards a computer-based delivery.

In 2022, Ireland's overall reading literacy mean score was 4.8 score points lower than in 2015, and 2.1 points lower than in 2018. Neither difference was statistically significant. A decline in reading literacy scores on average across the OECD was recorded in the same period, with the larger part of the decline occurring between 2018 and 2022. The reduction in the mean reading score across the OECD between 2015 and 2022 was 12.9 score points, and 10.3 between 2018 and 2022, both of which are statistically significant.

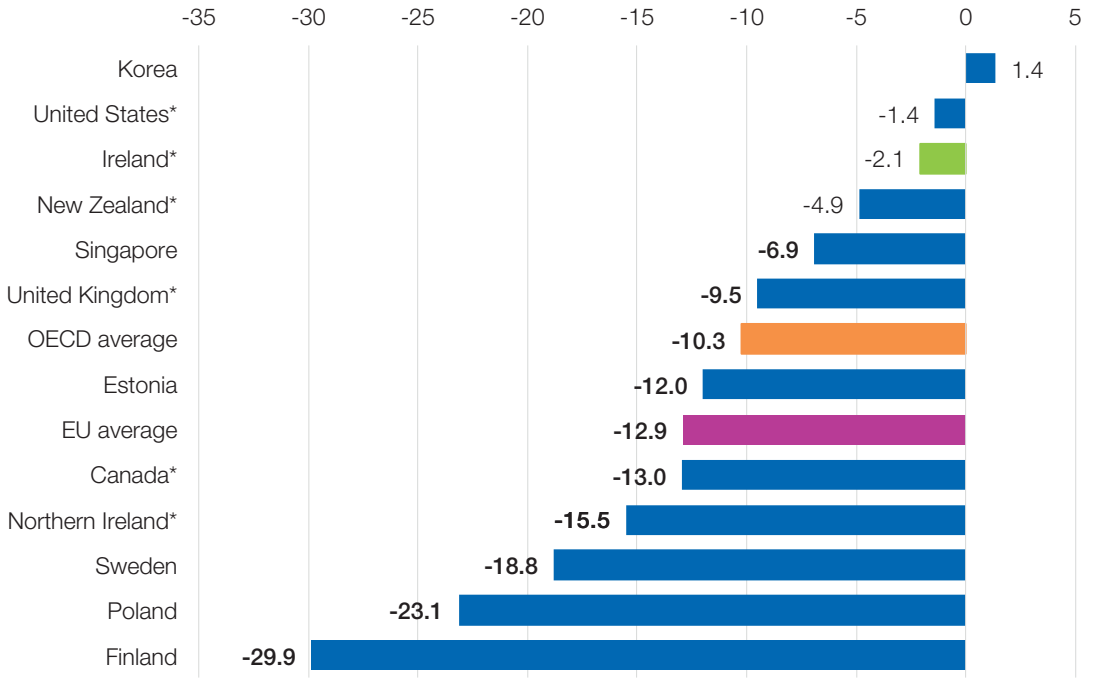
Figure 4.2: Mean scores on the overall reading literacy scale in Ireland and on average across OECD countries, 2015-2022



Source: OECD 2023c, Table I.B1.5.5.

Figure 4.3 shows the mean reading score difference across the comparison countries between the most recent cycles of PISA, 2018 and 2022. Only one of the comparison countries, Korea, demonstrated a higher mean reading performance score in 2022 than in 2018 with a modest and not statistically significant increase of 1.4 score points. United States (1.4 score points) and Ireland (2.1 score points) recorded small and not significant decreases in reading literacy performance in PISA 2022 compared to 2018. The reading performance in Singapore, which had the highest overall score in 2022, was down a significant 6.9 score points from 2018. The decline in reading performance across the EU countries on average was 12.9 score points, greater than the significant decline across OECD countries on average of 10.3 score points.

Figure 4.3: Change in mean achievement in reading PISA 2018-2022 in selected comparator countries, OECD and EU averages



Source: OECD 2023c, Table I.B1.5.5. Significant differences are in **bold**.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.
Note: EU average here is for 25 countries only, as it excludes data from Spain and Luxembourg.
See E-Appendix Table 4.4.

4.3 Performance on Reading Proficiency Levels

What follows in this section is an overview of the different proficiency levels that make up the PISA reading literacy scale. A description of the various reading literacy skills and abilities that students at each level possess is presented, alongside data on the proportion of students at each level in Ireland and across the OECD and EU. In addition, a comparison is presented between Ireland and selected countries of the percentages of students performing at the lowest and the highest proficiency levels. The section concludes with a trend analysis of students in Ireland performing at the lowest and highest reading literacy proficiency levels in PISA between 2015 and 2022.

The PISA reading literacy scale is divided into eight proficiency levels, which represent clusters of skills and describe the types of tasks that students at different levels of performance can be expected to successfully complete. Table 4.3 describes the types of skills that students at each level consistently demonstrate, as well as the cut-point scores and the percentages of students performing at each level in PISA 2022 in Ireland, on average across OECD countries, and on average across EU countries.

Earlier cycles of PISA included seven proficiency levels for reading (Level 6 to Level 1b), but the scale was expanded in 2018 to include more items with lower difficulty levels to allow the inclusion of a proficiency level below 1b (OECD, 2019a). Since 2018, the lowest proficiency level has been designated as 1c, with a cut-point score of 189. This has allowed for a better description of the abilities of students at the lower end of the proficiency spectrum.

Proficiency Level 2 is considered the baseline level of proficiency that students need to participate fully in society, and has been recognised as the minimum level of proficiency that students should reach before they reach the end of lower-secondary education in the United Nations Sustainable Development Goals (SDG 4; UNESCO Institute for Statistics, 2018 in OECD, 2019b). Since a student performing at a particular level is also expected to have acquired the skills identified at the lower levels, any student who attains Level 2 is also likely to possess the skills described in Levels 1a, 1b and 1c.

Proficiency levels 3-6 explicitly refer to students' ability to assess the quality and reliability of information and to deal with conflict between texts. Level 6 is the highest proficiency level, with a cut-point score of 698. Students who perform at Levels 5 and 6 are considered top performers.

Table 4.3. Summary description of the eight levels of proficiency on the PISA 2022 reading literacy scale and percentages of students achieving each level, in Ireland and on average across OECD and EU countries

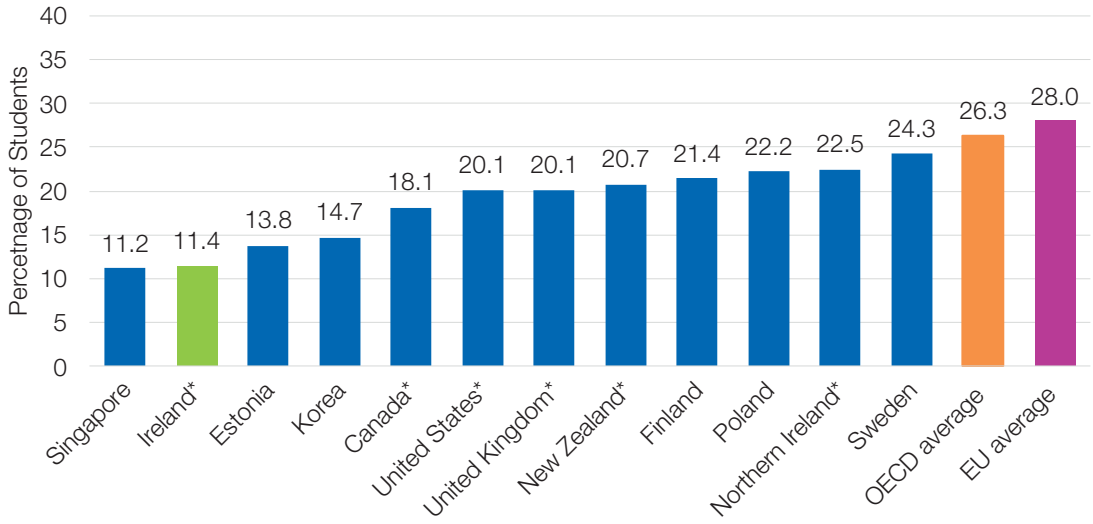
Level (Cut-point)	Students at this level can...	Ireland		OECD		EU	
		%	SE	%	SE	%	SE
6 (698.32 and above)	Comprehend lengthy and abstract texts in which the pertinent information is deeply embedded and indirectly related to the task. They can compare, contrast and integrate information from multiple and potentially conflicting perspectives. They can identify and resolve inter-textual discrepancies and conflicts by reflecting and making inferences about the sources of information, explicit or vested interests, and other cues as to the validity of the information and how it may be used.	1.1	(0.2)	1.2	(0.0)	0.7	(0.0)
5 (625.61 to less than 698.32)	Comprehend lengthy texts, inferring which information is relevant even when it may be easily overlooked. They can perform various types of reasoning based on a deep understanding of extended pieces of text. They can answer indirect questions by inferring the relationship between the question and information distributed within or across multiple texts. They can draw conclusions regarding the reliability of claims or conclusions offered in a piece of text.	9.1	(0.6)	6.0	(0.1)	5.2	(0.1)
4 (552.89 to less than 625.61)	Comprehend extended passages in single or multiple-text settings and compare perspectives and draw inferences based on multiple sources. They can locate and integrate several pieces of embedded information in the presence of plausible distractors and interpret nuances in a section of text by taking into account the whole text. They can reflect on strategies that authors use to convey their points, based on salient features of texts. They can assess the reliability of a source based on salient criteria.	25.2	(0.8)	16.9	(0.1)	16.2	(0.1)

Level (Cut-point)	Students at this level can...	Ireland		OECD		EU	
		%	SE	%	SE	%	SE
3 (480.18 to less than 552.89)	Represent the literal meaning of single or multiple texts in the absence of clues and generate more advanced inferences. They can information that is not prominent and/or is in the presence of distractors. They can compare and contrast several authors' viewpoints based on explicit information.	31.8	(0.9)	25.3	(0.1)	25.4	(0.2)
2 (407.47 to less than 480.18)	Identify the main idea in a text of moderate length. They can construe meaning or produce basic inferences within a limited part of the text when the information is not prominent and/or when the text(s) include some distracting information. They can select and access one page in a set based on explicit though sometimes complex prompts, and locate information based on multiple, partly implicit criteria. When explicitly cued, they can reflect on the overall purpose of a text or a detail in the text. They can reflect on simple visual or typographical features. They can compare claims and evaluate supporting reasons based on short, explicit statements.	21.4	(0.7)	24.4	(0.1)	24.5	(0.2)
1a (334.75 to less than 407.47)	Understand the literal meaning of sentences or short passages and recognise the main theme or author's purpose in a piece of text about a familiar topic. They can make a simple connection between adjacent pieces of information, or between given information and their prior knowledge. They can select a relevant page from a small set based on simple prompts, and locate information within short texts. They can reflect on the relative importance of information in simple texts containing explicit cues.	8.7	(0.6)	16.6	(0.1)	16.8	(0.2)
1b (262.04 to less than 334.75)	Evaluate the literal meaning of simple sentences and interpret the literal meaning of texts by making simple connections between adjacent pieces of information. They can scan for and locate a single piece of prominently placed, explicitly stated information in a single sentence, a short text or a simple list. They can access a relevant page from a small set based on simple prompts with explicit cues.	2.3	(0.3)	7.6	(0.1)	8.4	(0.1)
1c (189.33 to less than 262.04)	Understand and affirm the meaning of short, syntactically simple sentences on a literal level, and read for a clear and simple purpose within a limited amount of time.	0.3	(0.1)	1.9	(0.0)	2.5	(0.1)
Below 1c (Below 189.33)	There is insufficient information on which to base a description of the reading skills of these students.	0.0	(0.0)	0.2	(0.0)	0.3	(0.0)

Source: Adapted from OECD 2023c, Table I.B1.3.2. See E-Appendix Table 4.2 and 4.3.

In Ireland, 11.4% of students performed at the lowest proficiency levels (Below Level 2, see Figure 4.4 below), while the OECD average was 26.3%. Only one economy, Singapore, had a smaller proportion of students performing Below Level 2 than Ireland. Estonia and Korea had a slightly higher proportion of students performing at the lowest proficiency, with the remaining comparison countries having between one-fifth and one-quarter below this level. The EU average of 28.0% of students performing below Level 2, is larger than the figure for Ireland (11.4%).

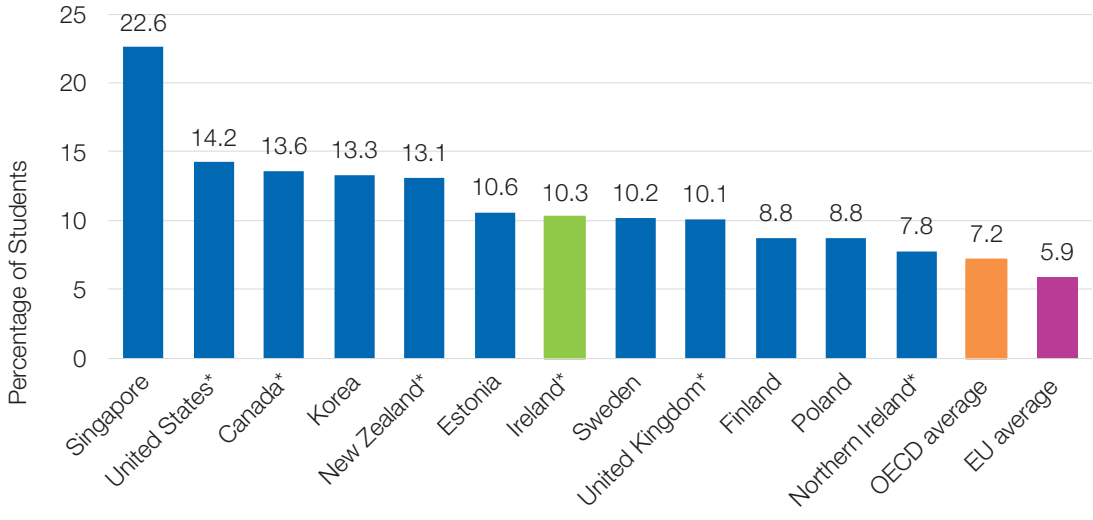
Figure 4.4. Percentages of students performing below Proficiency Level 2 on the reading scale in Ireland, in selected comparison countries, and on average across OECD and EU countries



Source: OECD 2023c, Table I.B1.3.2 and Table I.B2.13.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

At the opposite end of the achievement distribution, 10.3% of students in Ireland performed at Levels 5 and 6, which is higher than the OECD average of 7.2%, but similar to the levels found in Estonia (10.6%), Sweden (10.2%), and United Kingdom (10.1%), but less than half the proportion of students who performed at this level in Singapore (22.6%). Korea, which had an overall mean reading literacy score that was not significantly different to Ireland, had a proportion of students performing at the highest proficiency level that was 3.1 percentage points higher than Ireland. Ten countries/economies in PISA 2022 overall had higher proportions of top-performing students than Ireland, though across the EU on average, the percentage of students performing at Level 5 and above was lower (5.9%).

Figure 4.5. Percentages of students performing at or above Proficiency Level 5 on the reading scale in Ireland, in selected comparison countries, and on average across OECD and EU countries



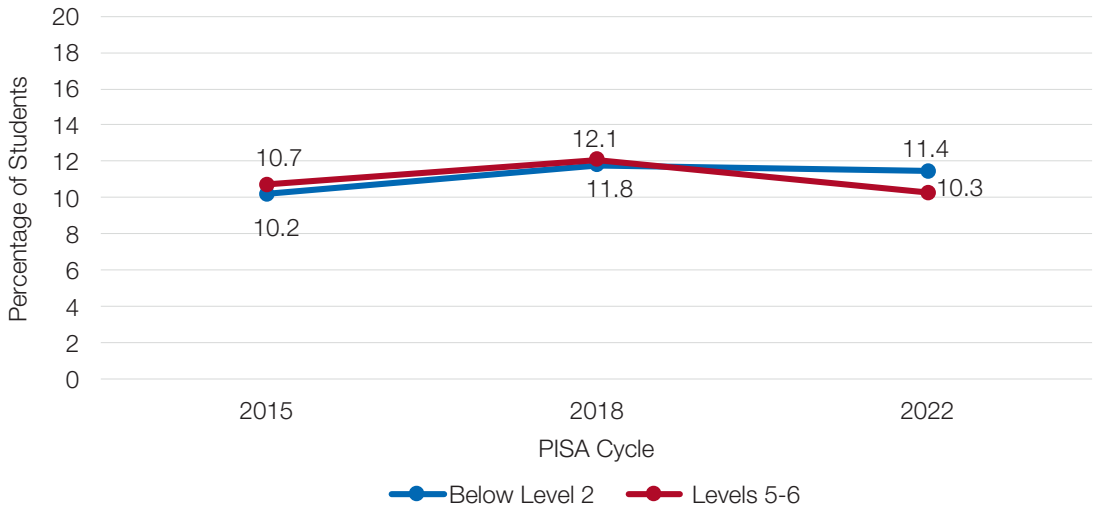
Source: OECD 2023c, Table I.B1.3.2 and Table I.B2.13.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

4.3.1 Trends in reading proficiency levels

The following section presents a trend analysis of the performance of students in Ireland at the lowest and highest reading literacy proficiency levels in recent cycles of PISA. Figure 4.6 shows the proportion of students in Ireland performing below Level 2, and at or above Level 5 between 2015 and 2022. The proportion of students in Ireland performing below Level 2 in 2022 was 11.4%. This was 1.3 percentage points higher than in 2015 and 0.4 percentage points lower than in 2018. Neither change was statistically significant. Across the OECD on average, the proportion of students performing below Level 2 increased significantly by 4.9 percentage points from 20.8% in 2015 to 25.7% in 2022.

The percentage performing at or above Level 5 in Ireland in 2022 was 10.3%, which was very similar to the corresponding percentage in 2015 (10.7%) and a non-significant fall of 1.8 percentage points in the most recent cycle. When looking at the OECD countries that had data available in 2015, 2018, and 2022, the percentage of students performing at Levels 5 and 6 remained relatively stable between 2015 (8.1%) and 2018 (8.8%) but declined significantly by 1.4 percentage points to 7.4% in 2022.

Figure 4.6: Percentage of students below Proficiency Level 2 and at or above Proficiency Level 5 on overall reading in Ireland, 2015-2022



Source: OECD 2023c, Table I.B1.5.2

4.4 Performance by Selected Variables

In this section, student performance on reading literacy is examined in relation to the following background variables: student gender, student socioeconomic status, student immigration status, school sector gender composition and school DEIS status.

4.4.1 Reading performance by gender

The analysis that follows gives a breakdown by gender of mean reading literacy performance in PISA 2022 in Ireland, selected comparison countries, and across the OECD on average. Of participating

students, 48.7% of students were female, while 51.3% were male (weighted percentages). Both male and female students in Ireland achieved higher mean reading scores than their counterparts on average across OECD countries. Male students in Ireland achieved a mean score that is 43.5 points higher than their OECD counterparts, while female students in Ireland outperformed their OECD peers by 37.6 points.

Within Ireland, female students outperformed male students by 18.3 points, which is a smaller gender gap than the OECD average of 24.2 points, although both are significantly significant.

Table 4.4. Gender differences in reading literacy performance in Ireland, in selected comparison countries and on average across OECD countries

	Males		Females		Difference (males-females)	
	Mean	SE	Mean	SE	Score diff.	SED
Singapore	533.0	(2.2)	552.6	(2.3)	**-19.6**	(2.5)
Ireland*	507.1	(3.1)	525.4	(3.0)	**-18.3**	(4.0)
Korea	499.1	(5.2)	533.3	(3.6)	**-34.2**	(5.6)
Estonia	498.1	(2.7)	524.8	(3.0)	**-26.7**	(3.2)
Canada*	495.2	(2.3)	519.5	(2.2)	**-24.3**	(2.3)
United States*	493.0	(5.0)	514.6	(4.3)	**-21.6**	(3.7)
New Zealand*	488.0	(2.8)	513.9	(3.0)	**-25.9**	(4.0)
United Kingdom*	486.3	(3.2)	502.8	(3.1)	**-16.5**	(4.1)
Northern Ireland*	475.7	(4.7)	494.0	(4.1)	**-18.3**	(5.5)
Poland	474.6	(3.2)	503.2	(3.2)	**-28.6**	(3.4)
Sweden	468.9	(3.1)	505.6	(2.6)	**-36.7**	(2.9)
Finland	468.3	(2.8)	513.0	(2.6)	**-44.7**	(3.0)
OECD average	463.6	(0.6)	487.8	(0.5)	**-24.2**	(0.6)

Source: Adapted from OECD 2023c, Table I.B1.4.18. Table I.B2.31 is the source of NI data. Significant differences are in **bold**.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

Among all comparison countries, female students significantly outperformed male students. Only United Kingdom had a smaller gender gap (16.5 points) than Ireland, while the gender gap in Northern Ireland (18.3 points) was the same as in Ireland. The gender gap was substantially higher in the two Scandinavian comparator countries: Finland (44.7 points) and Sweden (36.7 points).

A gender analysis was also carried out on the proportion of students performing at both the highest proficiency levels (Levels 5 and 6), and the lowest proficiency levels (below Level 2). In Ireland, a greater proportion of male students than female students performed below proficiency Level 2 in reading literacy (Figure 4.7). This gender difference of 6.2 percentage points is statistically significant. At the other end of the achievement distribution, a slightly greater proportion of female students than males performed at or above Level 5, although this gender difference of 1.8 percentage points is not statistically significant.

A similar pattern is observed on average across OECD countries at the highest and lowest proficiency levels in reading – the gender difference is in favour of female students. A significantly greater percentage of male students than female students achieved below Level 2 (a difference of 9.0 percentage points), and a significantly greater percentage of female students than male students performed at Level 5 or above (a difference of 2.0 percentage points). The proportions of male and female students performing below Level 2 are higher on average across OECD countries than in

Ireland, while the corresponding proportions at or above Level 5 are lower on average across OECD countries than in Ireland.

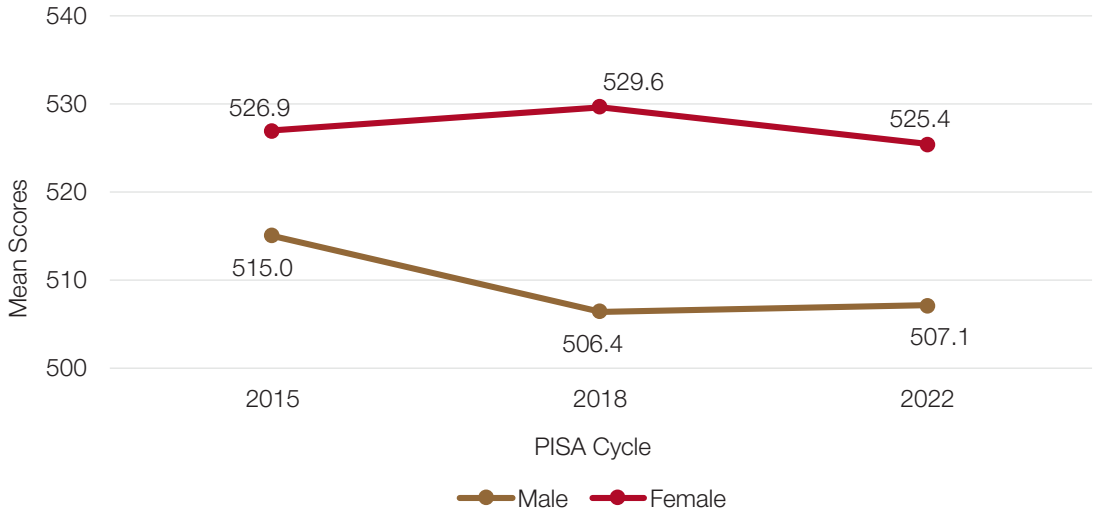
Figure 4.7. Percentages of male and female students achieving below Proficiency Level 2 and at or above Proficiency Level 5 on the overall reading literacy scale in Ireland, and on average across OECD countries

Source: OECD 2023c, Table I.B1.4.29.

4.4.2 Trends in reading performance by gender

The gender gap in overall reading literacy achievement in Ireland has widened between 2015 and 2022, albeit it has narrowed slightly in 2018. There was a reduction in overall reading scores for male students of 7.9 score points between 2015 and 2022, however this score increased by 0.7 score points between 2018 and 2022. The reading literacy score for female students decreased by 1.5 points between 2015 and 2022, and by 4.2 score points from 529.6 in 2018 to 525.4 in 2022. The changes between mean overall reading literacy scores for male and female students in this time were not statistically significant. As a result, the gap in reading literacy performance has widened from 12 score points in favour of female students in 2015 to 18.3 score points in 2022, down from a gap of 23.2 points in 2018.

Figure 4.8: Mean scores of male and female students on the overall reading literacy scale in Ireland, 2015-2022



Source: OECD 2023c, Tables I.B1.5.41 and I.B1.5.42.

Gender differences in achievement can also be reviewed across cycles with reference to proficiency levels. Table 4.5 describes the percentages of males and females below Level 2, and at or above Level 5 in Ireland in reading across three PISA cycles: 2015, 2018 and 2022.

The proportion of male students in Ireland performing below Level 2 in reading was relatively stable between the 2015 and 2022 cycles (12.3% and 14.5% respectively) with an increase of a non-significant 2.2 percentage points in this category. Similarly, for female students there was relative stability, with non-significant changes from 8.0% in 2015, to 8.5% in 2018, and to 8.2% in 2022.

On the other end of the performance distribution, the percentage of male students performing at or above Level 5 in reading again remained relatively stable between 2015, 2018 and 2022 (10.7%, 10.3% and 9.4% respectively), all differences were non-significant. However, the percentage of female students performing at or above Level 5 increased between 2015 and 2018 (from 10.7% to 13.8%) before decreasing in 2022 to 11.2%. The decrease of 2.6% between 2018 and 2022 is significant.

Table 4.5. Percentage of male and female students below Proficiency Level 2 and at or above Proficiency Level 5 on reading in Ireland, 2015, 2018, 2022

	Below Level 2				At or above Level 5			
	Male		Female		Male		Female	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.
2015	12.3	(1.1)	8.0	(0.8)	10.7	(0.9)	10.7	(1.0)
2018	15.1	(1.0)	8.5	(0.7)	10.3	(0.9)	13.8	(0.8)
2022	14.5	(1.1)	8.2	(0.8)	9.4	(0.8)	11.2	(1.0)
	Diff	**SED**	**Diff**	**SED**	**Diff**	**SED**	**Diff**	**SED**
2022-2015	2.2	(1.8)	0.2	(1.3)	-1.4	(1.3)	0.5	(1.5)
2022-2018	-0.6	(1.5)	-0.3	(1.1)	-1.0	(1.2)	**-2.6**	(1.3)

Source: OECD 2023c, Tables I.B1.5.48 and I.B1.5.50.

4.4.3 Reading performance by students' Economic, Social and Cultural Status (ESCS)

The index of students' Economic, Social and Cultural Status (ESCS) is a composite measure based on parental occupation, highest level of parental education, and home possessions related to family wealth, home educational resources and home possessions, as reported in Chapter 3. Students in Ireland reported a considerably higher mean ESCS score than their OECD peers (0.33 compared to 0.00). Similar to mathematics, the relationship between ESCS and reading performance appears to be very slightly weaker in Ireland than at the OECD average. In Ireland, 10.9% of the variance in reading performance is explained by ESCS compared to 12.6% at the OECD average, and a one-unit (i.e., one Standard Deviation) increase in ESCS is associated with an increase of 36.0 points on the reading scale, while the corresponding figure is 39.3 points at the OECD average (OECD, 2023b).

Students in Ireland who score in the bottom quartile of the ESCS index (i.e., those students who are experiencing the greatest levels of disadvantage) achieved a mean reading score that is significantly lower than the mean scores of all other students (Table 4.6), and is 75.6 points lower than the most advantaged students (i.e., those whose ESCS score is in the top quartile). The difference in mean reading performance between those scoring in the top and bottom quartiles of the ESCS index at the OECD average is 93.0 points.

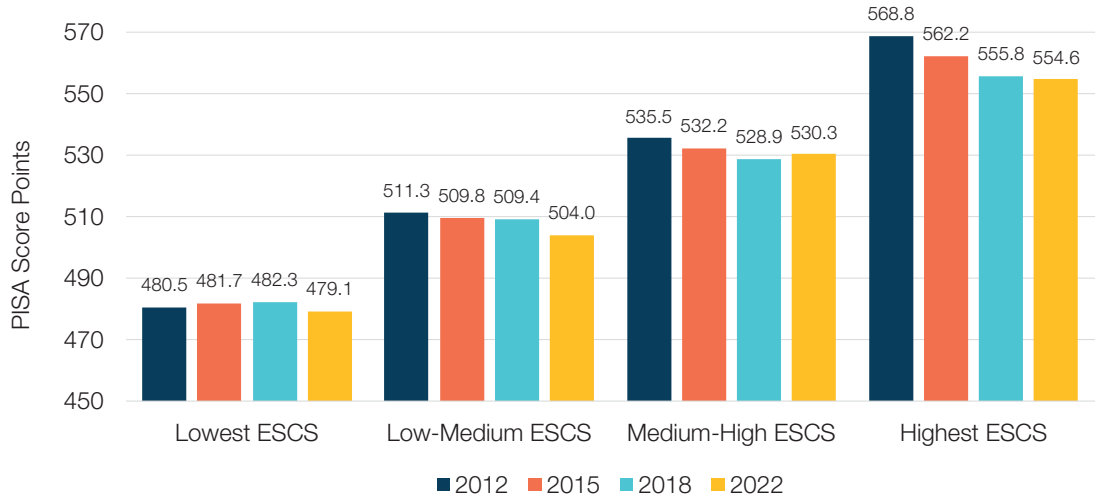
Table 4.6. Mean scores on reading by ESCS quartile, in Ireland

Quartiles of ESCS	%	Mean	SE	SD
Lowest *(ref. group)*	25.0	479.0	(3.5)	86.2
Low-Medium ESCS	25.0	**504.1**	(3.3)	82.1
Medium-High ESCS	25.0	**530.3**	(2.7)	79.3
Highest	25.0	**554.6**	(3.6)	83.8

Source: OECD 2023c, Table I.B1.4.4. Significantly different mean scores are in **bold** (compared with the reference group).

The reading performance of students in Ireland remained stable across each of the ESCS quartiles, with no significant differences observed in the short term (i.e., between 2018 and 2022) or when looking at longer-term trends over the last decade (i.e., between 2012 and 2022) (Figure 4.9). On the other hand, there were significant declines of between 6.1 and 12.8 points across each of the ESCS quartiles at the OECD average between 2018 and 2022, and larger declines (of between 12.8 points and 18.9 points) when comparisons are made between 2012 and 2022 (OECD, 2023b). As noted throughout this report, differences between PISA cycles should be interpreted with consideration of the known bias that is present in the 2022 sample.

Figure 4.9 Reading performance by ESCS quartile, in Ireland from 2012 to 2022



4.4.4 Student immigration status and reading performance

Immigrant status is an important predictor of student achievement, and is given special prominence in the PISA 2022 reporting. More detailed demographic information about immigrant students is provided in Chapter 3.

The performance difference between non-immigrant and immigrant students in Ireland for reading (13.0 score points in favour of non-immigrant students) is statistically significant but smaller than the OECD average difference (39.3 score points in favour of non-immigrant students).

Table 4.7 Students' mean reading performance by immigration status, in Ireland and on average across OECD countries

	Non-immigrant students		First-Generation immigrant students		Second-Generation immigrant students		Difference (Non-immigrant – Immigrant)	
	%	Mean (SE)	%	Mean (SE)	%	Mean (SE)	Score diff.	SED
Ireland	82.6	520.4 (2.4)	8.0	498.0 (5.8)	9.4	515.5 (4.6)	**-13.0**	4.2
OECD	87.1	483.5 (0.5)	5.4	425. 3 (1.9)	7.6	460.7 (1.5)	**-39.3**	1.4

Source: OECD 2023d, Table I.B1.7.1 and Table I.B1.7.21.
Significant differences are in **bold**.

4.4.5 Reading performance by school sector and gender composition

Table 4.8 presents the mean reading scores of students according to the type of school they attended, with five school types described based on their sector and gender composition: girls' secondary, boys' secondary, mixed secondary, community and comprehensive, and ETB vocational schools. Students attending girls' secondary schools achieved the highest mean reading score (531.8), which is significantly higher than the mean score achieved by students in ETB vocational schools (508.8). The mean reading score of students in ETB schools did not differ significantly from the mean scores of students in any of the other school types.

Table 4.8. Mean scores on reading by school type and gender composition, in Ireland

School type	%	Mean	SE	SD
Girls' secondary	17.8	**531.8**	(6.5)	82.0
Boys' secondary	16.5	519.7	(6.0)	90.7
Mixed secondary	19.1	518.8	(4.5)	85.5
Community/comprehensive*	16.2	505.2	(5.6)	87.8
ETB vocational *(ref. group)*	30.4	508.8	(3.5)	90.5

Significantly different mean scores are in **bold** (in comparison to the reference group).
*The vast majority of community/comprehensive and ETB schools have a mixed gender composition. As the number of single-sex community/comprehensive and ETB schools is very small, they are not considered as separate categories in this analysis.

4.4.6 Reading performance by DEIS status

In PISA 2022, students in DEIS schools achieved a mean reading score of 486.5, which is significantly lower, by 37.3 points, than their peers in non-DEIS schools (Table 4.9). However, as noted in Chapters 1 and 3, given the upward bias present in the PISA 2022 estimates and particularly the greater level of bias observed among students in DEIS schools, the estimated difference between the scores of students in DEIS and non-DEIS schools is likely to be an underestimate. Furthermore, the DEIS programme was extended in 2022 to include an additional 38 post-primary schools, meaning that two DEIS schools in the PISA 2022 sample were not classified as DEIS schools in 2018. Therefore, comparisons with the corresponding estimate in previous cycles should be interpreted with a high degree of caution.

Table 4.9. Mean scores on reading by DEIS status, in Ireland

DEIS Status	%	Mean	SE	SD
DEIS	21.0	**486.5**	(4.3)	90.2
Non-DEIS *(ref. group)*	79.0	523.8	(2.3)	86.0

Significantly different mean scores are in **bold** (compared with the reference group).

4.5 Summary

In PISA 2022, reading literacy was assessed as a minor domain, which meant a subset of the 2018 items were used. For the same reason, there was no analysis or reporting of reading literacy subscales.

Ireland's mean score of 516.0 on the reading scale was significantly higher than the OECD average of 475.6, and only one country, Singapore achieved a mean reading score (542.6) that was significantly higher than Ireland's. When a 95% confidence interval is applied, Ireland's mean reading score was between 511.4 and 520.6, which places Ireland between 2nd and 9th of all countries/economies taking part in PISA 2022, and between 1st and 6th among participating OECD countries.

Four countries, Japan, Korea, Chinese Taipei and Estonia reported reading literacy scores that were not significantly different to Ireland's, while 75 countries/economies had scores that were significantly lower than Ireland's.

Ireland's mean score on the reading literacy scale was 4.8 score points lower in 2022 than in 2015, and 2.1 points lower than in 2018, when reading literacy was last a major domain in the PISA study. This was lower than the fall in reading literacy scores across the OECD on average between 2015 and 2022 of 12.9 score points.

Only one of the comparison countries, Korea, saw an increase in mean reading performance between 2018 and 2022 (1.4 score points), although this change was not statistically significant. The decline in reading performance across OECD countries on average was substantially higher, at 10.3 score points.

Looking at proficiency levels, 11.4% of students in Ireland performed below baseline proficiency on the overall reading scale (below Level 2), which is considerably lower than the average across the OECD of 26.3%. Singapore was the only country with a lower proportion of students performing below baseline proficiency, recording a marginally lower figure of 11.2%.

Just over 10% students in Ireland performed at the highest proficiency levels on the overall reading scale (at or above Level 5), a similar proportion to Estonia, Sweden and United Kingdom, and higher than the proportion of students at this level in the OECD on average (7.2%). Overall, Ireland has fewer students with very low reading achievement, and more students with higher reading achievement than across the OECD on average.

There was a slight upward trend in the proportion of students in Ireland performing below Level 2, between 2015 and 2022, up 1.3 percentage points to 11.4% in 2022. This compares to a corresponding increase across the OECD on average over the same time period of 4.9 percentage points to 25.7% in 2022.

The percentage of students performing at or above Level 5 in Ireland was very similar to the corresponding percentage in 2015, but slightly if not significantly lower than in 2018 (a drop of 1.8 percentage points). The corresponding percentages for the OECD on average remained stable between 2015 (8.1%) and 2018 (8.8%) but a significant decline of 1.4 percentage points to 7.4% was observed in 2022.

In Ireland, female students achieve higher scores overall on the reading literacy scale, outperforming male students by 18.3 score points. This gap is on a par with United Kingdom and Northern Ireland. The difference in reading literacy performance between male and female students across the OECD on average is somewhat higher, at 24.2 score points in favour of female students.

A greater proportion of male students than female students in Ireland performed below Proficiency Level 2. This gender difference of 6.2 percentage points is statistically significant. At the other end of the scale, a slightly greater proportion of girls than boys performed at or above Level 5, although this gender difference of 1.8 percentage points is not statistically significant. The pattern is similar across OECD countries on average, but more pronounced at the lowest level of proficiency.

In Ireland, the difference in overall reading literacy achievement between male and female students widened from 12 score points in favour of female students in 2015 to 18.3 score points in 2022, however this is lower than the gap of 23.2 points in 2018. There was a reduction in overall reading literacy scores for male students of 7.9 score points between 2015 and 2022, and a fall of 1.5 score points between for female students in Ireland over the same period.

Students in Ireland reported a considerably higher mean Economic Social and Cultural Status (ESCS) index score than their OECD peers (0.33 compared to 0.00), and the relationship between ESCS and reading performance appears to be very slightly weaker in Ireland than at the OECD average.

Students in Ireland who experience the greatest levels of disadvantage, as measured by ESCS, achieved a mean reading score that is significantly lower than the mean scores of all other students, and is 75.6 points lower than the most advantaged students. The difference in mean reading performance between those scoring in the top and bottom quartiles of the ESCS index at the OECD average is 93.0 points.

The reading performance of students in Ireland remained stable across each of the ESCS quartiles, with no significant differences observed since 2018 or looking further back to 2012. However, there were significant declines at the OECD average, of between 6.1 and 12.8 points across each of the ESCS quartiles between 2018 and 2022, with larger declines observed (of between 12.8 points and 18.9 points) when comparisons are made between 2012 and 2022 (OECD, 2023b).

Students from a non-immigrant background in Ireland performed 13.0 points higher on the overall reading literacy scale than students from an immigrant background, which is smaller than the corresponding difference among students on average across the OECD of 39.3 score points, in favour of non-immigrant students.

Examining reading performance by school type, students attending girls' secondary schools were shown to have achieved the highest mean reading score (531.8). This was significantly higher than the mean score achieved by students in ETB vocational schools (508.8), which in turn did not differ significantly from the mean scores of students in any of the other school types.

Students in DEIS schools achieved a mean reading score of 486.5 in 2022, which is significantly lower, by 37.3 points, than their peers in non-DEIS schools. However, as noted throughout this report, given the greater level of bias observed among students in DEIS schools, the estimated difference between the scores of students in DEIS and non-DEIS schools is likely to be an underestimate and comparisons with the corresponding estimate in previous cycles should be interpreted with a high degree of caution.

Chapter 5: Performance on Science

Key Findings 2022

- **The mean science score for students in Ireland in PISA 2022 is 503.8. This is significantly higher than the OECD average of 484.6 score points.**
- **Nine countries/economies had mean science scores significantly higher than Ireland's, while eight had scores that were not significantly different to Ireland's.**
- **Ireland's standard deviation for science (91.3 score points) is smaller than the OECD average (97.5).**
- **In Ireland, male students achieved a mean science score of 506.6, while females achieved a mean score of 501.0. However, the difference of 5.6 score points was not statistically significant.**
- **Ireland's mean score in science increased by a statistically significant 7.7 score points since the last PISA cycle in 2018 bringing achievement close to 2015 values.**

This chapter is divided into five sections:

- A description of the framework underpinning PISA science (in 2015, 2018 and 2022);
- A description of students' performance on PISA 2022 science, with reference to performance in other participating countries, and across PISA cycles;
- A description of performance on PISA 2022 science, in terms of the percentages of students achieving different science proficiency levels in Ireland, and in other participating countries, and across PISA cycles;
- An examination of key factors associated with achievement in PISA 2022 in Ireland: two student-level factors (gender and socioeconomic status), and two school-level factors (school sector and gender composition and DEIS status), and across PISA cycles;
- A summary of the key findings from the chapter.

As noted in earlier chapters, Ireland's weighted student-level response rate in PISA 2022 (76.8%) fell below the minimum threshold outlined by the PISA Technical Standards. Ireland carried out a Non-Response Bias Analysis (NRBA) to assess the potential for bias in the PISA 2022 estimates and evidence of an upward bias of approximately one-tenth of a standard deviation, or 8 to 9 points on the PISA scale in the achievement estimates for Ireland was found. This analysis also indicated that the bias was likely to be larger for male students and students in DEIS schools. This means that the estimates presented in this chapter are likely to be somewhat of an overestimation of Ireland's 'true' performance if all selected students had completed the test. Therefore, the figures presented in this chapter should be interpreted with consideration of the results of the NRBA and particular caution should be applied when comparisons are made with the findings from previous cycles and among subgroups of the population.

5.1 Framework for Science

This section describes the PISA science framework employed for the science assessment in 2022. The most recent update to the PISA science framework occurred in 2015, when science was last assessed as the main domain, and this framework was used in both PISA 2018 and PISA 2022 (OECD, 2023c).[36]

Firstly, a definition of science literacy under the PISA framework is provided. Secondly, there is a description of the range of science competencies assessed in PISA 2022, the types of scientific and content knowledge and scientific attitudes assessed, the contexts of the assessment items, and the type of science items students were exposed to during the PISA 2022 assessment.

5.1.1 Definition of scientific literacy

In PISA, scientific literacy is developed through a science education that is both broad and applied in its pedagogical approach. Within PISA, scientific literacy is seen not just as knowledge of the theories and ideas within science, but also a familiarity with the common applications of this knowledge, the practices associated with scientific enquiry and how science can advance through these practices (OECD, 2019a).

Within the PISA science framework, science literacy is defined as follows:

> the ability to engage with science-related issues, and with ideas of science, as a reflective citizen. A scientifically-literate person, therefore, is willing to engage in reasoned discourse about science and technology, which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically (OECD, 2019a, p.100).

The focus on 'scientific literacy' here rather than science, serves to highlight the importance PISA assigns to not just the knowledge of the domain, but the student's ability to apply these scientific concepts to real-life contexts and problems. PISA science literacy incorporates not only science, but also science-based technologies, recognising the relationship between scientific knowledge and technology.

5.1.2 Range of scientific competencies

PISA science 'assesses competencies and knowledge in specific contexts. These contexts are chosen on the basis of the knowledge and understanding that students are likely to have acquired by the age of 15' (OECD, 2017, p.25).

- According to the PISA science framework, a scientifically proficient person engages willingly with science-related issues, and this requires the following competencies: the ability to **explain phenomena scientifically** – that is to recognise, offer, and evaluate explanations for a range of natural and technological phenomena.
- The capacity to **evaluate and design scientific enquiry**: this means describing and appraising scientific investigations, as well as proposing ways of addressing questions scientifically.

[36] Science will be the main domain in PISA 2025 and in preparation for this, a new assessment framework and item pool has been developed and is available to view at https://pisa-framework.oecd.org/science-2025/

- The capacity to **interpret data and evidence scientifically**: that is to analyse and evaluate data, claims and arguments in a variety of ways and draw appropriate scientific conclusions from this evidence.

5.1.3 Scientific knowledge, content and contexts

Within the science framework, performance in science requires three forms of knowledge. These types of knowledge are not entirely distinct and have areas of overlap.

- **Content knowledge of both the natural world and technological artefacts**. This covers three content areas – Physical Systems, Living Systems and Earth and Space Systems – that are equally represented among PISA science items.
- **Procedural knowledge** of the standard methodological procedures used in science.
- **Epistemic knowledge** of the reasons and ideas used by scientists to justify their claims including the role that questions, observations, theories, hypotheses, models and arguments play in science.

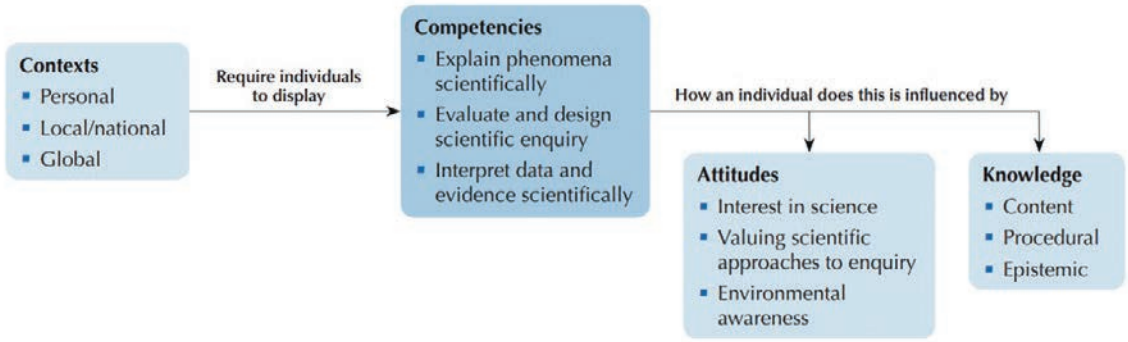
Further, the PISA science framework specifies three content areas that are represented within the science items in the assessment. They are:

- **Physical systems –** items here draw on knowledge of the structure and properties of matter, chemical changes of matter, motion and forces, energy and its transformation, as well as interactions between energy and matter.
- **Living systems –** items here draw on knowledge of the structure and functions of the cell, the concept of an organism, human biology, populations, ecosystems, and the biosphere.
- **Earth and space systems –** items here draw on knowledge about the structure of earth systems, changes in those systems, the earth's history, earth in space, and the history and scale of the universe (OECD, 2017, p.28).

In addition, in PISA 2022, science students were assessed on their ability to display science competencies in the following contextual settings: **personal, community,** and **global**. Finally, the PISA science assessment items can be categorised into five areas of science and technology: health and disease, natural resources, environmental quality, hazards, and the frontiers of science and technology.

In summary, the PISA science framework has four key aspects (Figure 5.1): contexts, knowledge, competencies and attitudes. While the attitudes element was assessed through questionnaire items in 2015, it was not assessed in the 2018 and 2022 cycles, as science was a minor domain in both cycles.

Fig 5.1 Inter-relations between the four key aspects of the PISA science framework



Source: (OECD, 2017, p.25)

5.1.4 Item types and distribution of science items by framework components

As science was assessed as a minor domain in 2022, a smaller number of items were assessed relative to the mathematics domain. This section looks at the type of science questions students see in the PISA assessment.

As in previous cycles of PISA, three main types of items were used to assess science in PISA 2022. This included simple multiple choice, complex multiple choice and open response items. Simple multiple-choice questions require the selection of a single response from four options, selection of a 'hot spot' within a graphic or text, or selection of an option from a drop-down menu. Complex multiple-choice items require the selection of responses to a series of yes/no questions that are treated as a single question; the selection of more than one response from a list; the completion of a sentence by selecting drop-down choices to fill multiple blanks; or 'drag and drop' responses allowing students to move elements on screen to complete a task of matching, ordering or categorising. Both types of multiple-choice items are computer-scored. Constructed response (open response) items instead are coded by humans, and these consist of responses in the form of written responses (ranging from a phrase to a paragraph). A small number of such responses in science call for a drawing, supported by a simple drawing editor where required. Some constructed response items are computer-scored (e.g., where students were asked to 'drag and drop' to indicate the relative size of objects). The others are scored by trained markers. Interactive items were first introduced to the PISA science section of the assessment in 2015.

The distribution of science items in the 2018 and 2022 cycles by competence, knowledge type and context along with the type or item is presented in Table 5.1 below. This is a subset of the items assessed in 2015, when science was last the major domain.

Table 5.1. Distribution of PISA 2018 and 2022 science items by competence, knowledge type, system, context and format – number and percent

Component	Number	%	Component	Number	%
Science Competences			**Knowledge Types**		
Explain phenomena scientifically	49	42.6	Content	49	42.6
Evaluate and design scientific enquiry	30	26.1	Procedural	47	40.9
Interpret evidence and data scientifically	36	31.3	Epistemic	19	16.5
Content Knowledge Systems			**Context 1**		
Physical	38	33.0	Global	34	29.6
Living	47	40.9	Local/National	70	60.9
Earth & Space	30	26.1	Personal	11	9.6
Format			**Context 2**		
Simple multiple choice – Comp Sc.	33	28.7	Environmental Quality	24	20.9
Complex multiple choice – Comp Sc.	47	40.9	Frontiers	30	26.1
Open constructed response: Human Cd.	32	27.8	Hazards	12	10.4
Open constructed response: Comp. Sc.	3	2.6	Health and Disease	17	14.8
			Natural Resources	32	27.8

Source: McKeown et al., 2019, Table 4.1.[37]

After the 2015 PISA assessment, where science was the main domain, a number of sample items from the assessment were released into the public realm. For a description of a selected number of these items, please see McKeown et al (2019) and https://www.oecd.org/pisa/test/

5.2 Overall Performance on Science

This section examines the performance of students in the PISA science assessment in 2022. It examines the relationship between the performance of students in Ireland to that of their peers in participating countries/economies, including a comparison of Ireland's science performance across recent cycles of the study.

As science was a minor domain in PISA 2022 and was last the major assessment subject in PISA 2015, some analysis in this chapter will refer to the 2015 cycle and results as a reference point. The mean performance of students in PISA 2022 is presented on an overall scale, and not at subscale level.

[37] As science was a minor domain in both the 2018 and 2022 cycles, the distribution of science items did not change between cycles.

Students in Ireland achieved a mean PISA 2022 science score of 503.8 which is significantly higher than the OECD average of 484.6, by 19.2 score points (Table 5.2). Ireland was among 24 countries with a mean science score above the OECD average, which included United Kingdom, Canada and United States.

When a 95% confidence interval is applied to the science data, Ireland's mean performance lies between 499.4 and 508.3 score points. Therefore, Ireland is placed between 8th and 25th among all participating countries and economies, and between 5th and 20th among OECD countries (OECD 2023c, Table I.2.6).

Mean overall science scores are presented for all participating countries/economies in Table 5.2. Of the 81 participating countries/economies in PISA 2022, nine countries/economies had mean science scores significantly higher than Ireland's (Singapore, Japan, Macao, Chinese Taipei, Korea, Estonia, Hong Kong, Canada, and Finland). Eight were not significantly different from Ireland (Australia, New Zealand, Switzerland, Slovenia, United Kingdom, United States, Poland, and Czech Republic), and the remaining 63 countries/economies had significantly lower mean science scores than Ireland.

The mean score for Northern Ireland was 488.4 (SE = 3.2; SD = 99.6 see E-Appendix Table 5.1). This is significantly lower than Ireland's mean score of 503.8 (OECD 2023c, Table I.B2.3). The EU average science score was 480.6, considerably lower than Ireland's average value (503.8). Of the 26 EU member countries that participated in PISA 2022, seven countries performed below the EU mean science achievement (Italy, Malta, Slovak Republic, Greece, Romania, Bulgaria and Cyprus). Only two EU countries had higher mean achievement in science (Estonia 525.8 and Finland 511.0).

Table 5.2 also shows the standard deviation for each country/economy participating in PISA 2022. Ireland has a lower standard deviation (91.3) than the average across OECD countries (97.5) and EU countries (97.7), indicating that the results for students in Ireland had a lower degree of spread.

Table 5.2. Mean scores, standard deviations (SD) and standard errors (SE) for all countries/ economies, the OECD average and the EU average on the overall science scale, and positions relative to OECD average and mean score for Ireland.

	Mean	SE	SD	SE	IRL		Mean	SE	SD	SE	IRL
Singapore	561.4	(1.3)	99.1	(1.1)	▲	*Brunei Darussalam*	445.9	(1.3)	93.6	(1.0)	▼
Japan	546.6	(2.8)	93.0	(1.7)	▲	Chile	443.5	(2.5)	91.8	(1.4)	▼
Macao (China)	543.1	(1.1)	87.6	(1.5)	▲	Greece	440.8	(2.8)	90.8	(1.6)	▼
Chinese Taipei	537.4	(3.3)	102.6	(2.0)	▲	*Uruguay*	435.4	(2.5)	91.6	(1.4)	▼
Korea	527.8	(3.6)	105.5	(2.7)	▲	*Qatar*	432.4	(1.5)	96.9	(1.3)	▼
Estonia	525.8	(2.1)	89.2	(1.3)	▲	*United Arab Emirates*	432.0	(1.3)	109.9	(1.3)	▼
*Hong Kong (China)**	520.4	(2.8)	93.1	(1.7)	▲	*Romania*	427.5	(3.9)	96.1	(1.7)	▼
Canada*	515.0	(1.9)	100.6	(1.1)	▲	*Kazakhstan*	423.2	(1.7)	77.8	(1.3)	▼
Finland	511.0	(2.5)	106.4	(1.1)	▲	*Bulgaria*	421.0	(3.2)	94.6	(1.9)	▼
Australia*	507.0	(1.9)	108.9	(1.4)	O	*Moldova*	416.9	(2.4)	83.0	(1.5)	▼
New Zealand*	504.1	(2.2)	107.2	(1.5)	O	*Malaysia*	416.3	(2.3)	78.6	(2.2)	▼
Ireland*	503.8	(2.3)	91.3	(1.1)		*Mongolia*	412.4	(2.4)	76.1	(1.3)	▼
Switzerland	502.5	(2.2)	99.5	(1.3)	O	Colombia	411.1	(3.3)	86.8	(1.7)	▼
Slovenia	500.0	(1.4)	94.2	(1.6)	O	Costa Rica	411.0	(2.4)	80.2	(1.3)	▼
United Kingdom*	499.7	(2.4)	103.8	(1.4)	O	*Cyprus*	410.9	(1.5)	105.2	(1.5)	▼
United States*	499.4	(4.3)	108.1	(1.8)	O	Mexico	409.9	(2.4)	74.9	(1.7)	▼
Poland	499.2	(2.5)	96.2	(1.5)	O	*Thailand*	409.3	(2.8)	81.5	(1.9)	▼
Czech Republic	497.7	(2.3)	99.5	(1.4)	O	*Peru*	407.8	(2.6)	85.7	(1.3)	▼
Latvia*	493.8	(2.3)	84.9	(1.2)	▼	*Argentina*	406.2	(2.5)	85.7	(1.2)	▼
Denmark*	493.8	(2.5)	94.7	(1.6)	▼	*Montenegro*	403.1	(1.2)	83.5	(1.1)	▼
Sweden	493.5	(2.4)	108.3	(1.7)	▼	*Brazil*	403.0	(1.9)	94.1	(1.3)	▼
Germany	492.4	(3.5)	106.4	(1.5)	▼	*Jamaica**	402.9	(3.9)	94.2	(1.8)	▼
Austria	491.3	(2.7)	101.1	(1.4)	▼	*Saudi Arabia*	390.4	(2.0)	69.6	(1.4)	▼
Belgium	490.6	(2.5)	101.0	(1.3)	▼	*Panama**	387.8	(3.5)	87.7	(2.2)	▼
Netherlands*	488.3	(4.1)	112.3	(2.2)	▼	*Georgia*	384.1	(2.3)	81.1	(1.9)	▼
France	487.2	(2.7)	103.0	(1.5)	▼	*Indonesia*	382.9	(2.6)	70.5	(1.3)	▼
Hungary	485.9	(2.7)	96.5	(1.6)	▼	*Baku (Azerbaijan)*	380.1	(2.2)	78.0	(1.3)	▼
Spain	484.5	(1.6)	91.7	(0.8)	▼	*North Macedonia*	379.9	(0.9)	81.9	(0.9)	▼
Lithuania	484.5	(2.3)	92.4	(1.3)	▼	*Albania*	376.0	(2.2)	82.6	(1.4)	▼
Portugal	484.4	(2.6)	92.0	(1.4)	▼	*Jordan*	374.5	(2.4)	74.2	(1.4)	▼
Croatia	482.7	(2.4)	93.1	(1.6)	▼	*El Salvador*	373.1	(2.6)	73.7	(1.3)	▼
Norway	478.2	(2.4)	106.0	(1.2)	▼	*Guatemala*	373.0	(2.2)	64.7	(1.7)	▼
Italy	477.5	(3.2)	92.8	(1.7)	▼	*Palestinian Authority*	368.8	(2.1)	71.8	(1.3)	▼
Türkiye	475.9	(1.9)	89.4	(1.1)	▼	*Paraguay*	368.3	(2.1)	76.5	(1.2)	▼
Viet Nam	472.4	(3.6)	78.3	(1.8)	▼	*Morocco*	365.4	(3.4)	67.1	(1.7)	▼
Malta	465.6	(1.7)	102.3	(1.4)	▼	*Dominican Republic*	360.4	(2.0)	69.1	(1.1)	▼
Israel	464.8	(3.4)	109.1	(1.7)	▼	*Kosovo*	357.0	(1.3)	65.8	(1.0)	▼
Slovak Republic	462.3	(3.0)	103.3	(1.9)	▼	*Philippines*	356.2	(3.1)	77.5	(2.1)	▼
Ukrainian regions (18 of 27)	450.2	(3.8)	90.1	(2.0)	▼	*Uzbekistan*	354.9	(2.0)	62.6	(1.0)	▼
Serbia	447.5	(2.9)	91.0	(2.2)	▼	*Cambodia*	347.1	(2.1)	50.8	(1.2)	▼
Iceland	446.9	(1.8)	94.8	(1.4)	▼	OECD average	484.6	(0.4)	97.5	(0.3)	▼
						EU average	480.6	(0.5)	97.7	(0.3)	▼

	Significantly above OECD average		▲	Significantly higher than Ireland
	At OECD average		O	Not significantly different from Ireland
	Significantly below OECD average		▼	Significantly lower than Ireland

Source: OECD 2023c, Table I.B1.2.3

OECD countries are in regular font, partner countries/economies are in *italics*.

*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details. Estimates for United Kingdom include data from Northern Ireland, Scotland, Wales and England. Achievement data for Northern Ireland are described in each chapter and in tabular form in the E-Appendix.

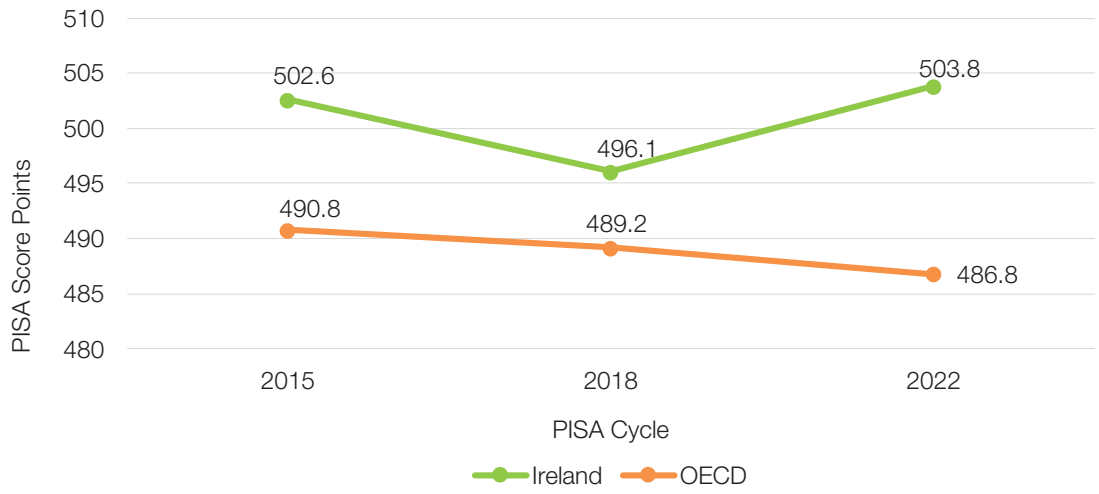
5.2.1 Trends in science performance

This section examines trends in science performance between 2015, the last cycle in which science was the major assessment domain in PISA, and 2022 when science was a minor assessment domain. As with all trend analysis for Ireland, differences between PISA cycles should be interpreted with consideration of the known bias in the 2022 estimates.

Examining the trend between 2015 and 2022 (Figure 5.2), the average science performance in Ireland in 2015 (502.6) and 2022 was similar (503.8). However, there was a small decrease in the intervening cycle (2018) when mean science achievement dropped to 496.1. Ireland's mean score is 7.7 score points higher in 2022 than in 2018, and this is significantly higher, whereas there was a non-significant increase of 1.3 points between 2015 and 2022 (OECD 2023c, Table I.B1.5.6).

In contrast at the OECD average level, countries had a corresponding statistically significant decline of 4.0 score points for the same time period (2015-2022) (OECD 2023c, Table I.B1.5.6). The drop from 2018 to 2022 corresponds to a drop of 2.4 score points, but was non-significant.

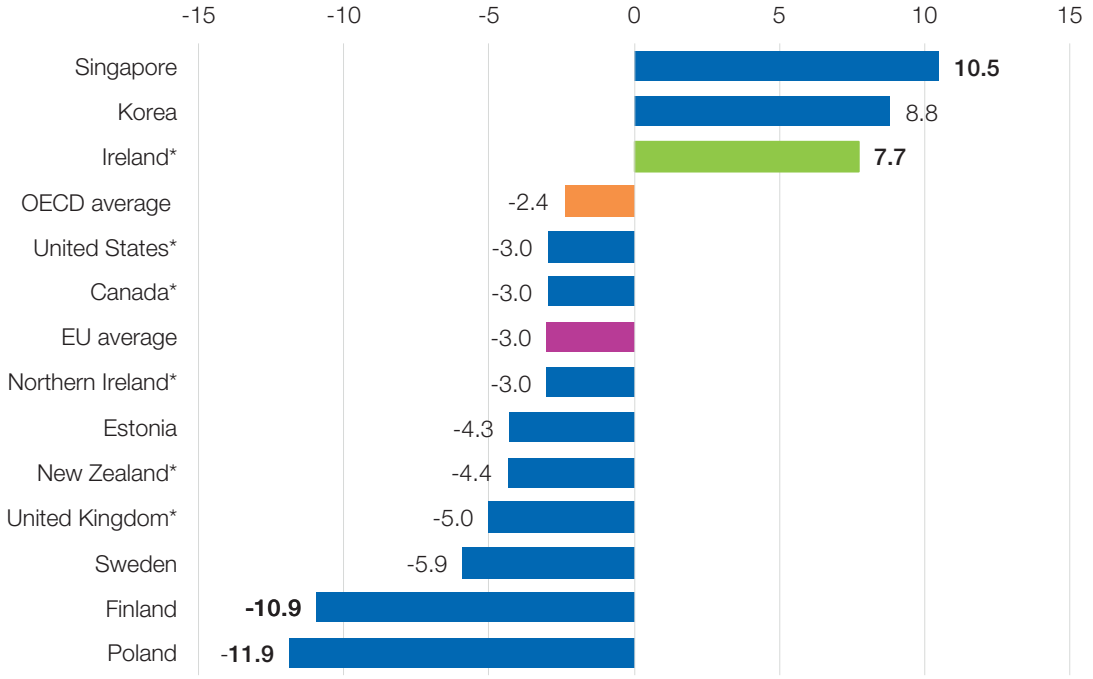
Figure 5.2. Mean scores on the overall science scale in Ireland, and on average across the OECD, 2015-2022



Source: OECD 2023c, Table I.B1.5.6.

As in previous chapters, a number of countries were selected for comparison with Ireland. Results for these eleven comparator countries, the OECD and EU averages, were considered and contrasted to figures for students in Ireland during cycles 2018 to 2022 (Figure 5.3). Singapore showed a significant improvement of 10.5 mean score points in this period, while Ireland showed a significant increase of 7.7 points. Korea showed a non- significant improvement of 8.8. In contrast, both Poland and Finland had significant drops (11.9, 10.9 mean score points respectively) during the same timeframe. All other comparator countries displayed non-significant declines ranging from close to six points in Sweden, to three points for students in United States. Northern Ireland and United Kingdom displayed similar non-significant declines (3.0 and 5.0 score points respectively). Performance declines in EU and OECD averages were also non-significant.

Figure 5.3. Change in mean achievement in science PISA 2018-2022 in selected comparator countries, OECD and EU averages



Source: OECD 2023c, Table I.B.1.5.6.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.
See E-Appendix Table 5.4.

5.3 Performance on Science Proficiency Levels

Overall mean achievement gives one perspective on student performance in science. Another view on performance can be gained by looking at achievement by proficiency level. The OECD defines the basic levels of proficiencies as 'the level at which students are able to tackle tasks that require, at least, a minimal ability and disposition to think autonomously' (OECD, 2016, p.264).

PISA describes performance in science in terms of seven proficiency levels. Table 5.3 details the types of tasks students can successfully complete at each level. Level 2 is considered the baseline level of proficiency that students need to participate fully in society, while students who perform at the highest levels (Levels 5 and 6) are considered high achievers. Students performing at Levels 1a, 1b and those performing below Level 1b are often referred to as lower-achieving students. This analysis combines the proficiency levels Below Level 1a, Level 1a, and Level 1b into one group called 'below proficiency Level 2'.

Table 5.3 Summary description of the eight levels of proficiency in the science scale, and percentages of students achieving each level, in Ireland, and on average across OECD and EU countries

Level (Cut-point)	Students at this level can:	Ireland		OECD		EU Avg	
		%	SE	%	SE	%	SE
6 (707.93 and above)	Drawing on a range of interrelated scientific ideas and concepts from the physical, life, and earth and space sciences and use content, procedural and epistemic knowledge in order to offer explanatory hypotheses of novel scientific phenomena, events and processes or to make predictions. In interpreting data and evidence, they are able to discriminate between relevant and irrelevant information and can draw on knowledge external to the normal school curriculum. They can distinguish between arguments that are based on scientific evidence and theory and those based on other considerations. Level 6 students can evaluate competing designs of complex experiments, field studies or simulations and justify their choices.	0.8	(0.2)	1.2	(0.0)	0.9	(0.0)
5 (633.33 to less than 707.93)	Using abstract scientific ideas or concepts to explain unfamiliar and more complex phenomena, events and processes involving multiple causal links. They are able to apply more sophisticated epistemic knowledge to evaluate alternative experimental designs, justify their choices, and use theoretical knowledge to interpret information or make predictions. Level 5 students can evaluate ways of exploring a given question scientifically and identify limitations in interpretations of data sets, including sources and the effects of uncertainty in scientific data.	6.8	(0.4)	6.3	(0.1)	5.6	(0.1)
4 (558.73 to less than 633.33)	Using more complex or more abstract content knowledge, which is either provided or recalled, to construct explanations of more complex or less familiar events and processes. They can conduct experiments involving two or more independent variables in a constrained context. They are able to justify an experimental design by drawing on elements of procedural and epistemic knowledge. Level 4 students can interpret data drawn from a moderately complex data set or less familiar context, draw appropriate conclusions that go beyond the data and provide justifications for their choices.	21.0	(0.7)	17.2	(0.1)	16.7	(0.1)
3 (484.14 to less than 558.73)	Drawing on moderately complex content knowledge to identify or construct explanations of familiar phenomena. In less familiar or more complex situations, they can construct explanations with relevant cueing or support. They can draw on elements of procedural or epistemic knowledge to carry out a simple experiment in a constrained context. Level 3 students are able to distinguish between scientific and non-scientific issues and identify the evidence supporting a scientific claim.	30.4	(0.8)	25.7	(0.1)	26.2	(0.2)
2 (409.54 to less than 484.14)	Drawing on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation, interpret data, and identify the question being addressed in a simple experimental design. They can use basic or everyday scientific knowledge to identify a valid conclusion from a simple data set. Level 2 students demonstrate basic epistemic knowledge by being able to identify questions that can be investigated scientifically.	25.4	(0.9)	25.2	(0.1)	25.5	(0.2)

Level (Cut-point)	Students at this level can:	Ireland		OECD		EU Avg	
		%	SE	%	SE	%	SE
1a (334.94 to less than 409.54)	Using basic or everyday content and procedural knowledge to recognise or identify explanations of simple scientific phenomena. With support, they can undertake structured scientific enquiries with no more than two variables. They are able to identify simple causal or correlational relationships and interpret graphical and visual data that require a low level of cognitive demand. Level 1a students can select the best scientific explanation for given data in familiar personal, local and global contexts.	12.1	(0.7)	17.1	(0.1)	17.1	(0.2)
1b (260.54 to less than 334.94)	Using basic or everyday scientific knowledge to recognise aspects of familiar or simple phenomena. They are able to identify simple patterns in data, recognise basic scientific terms and follow explicit instructions to carry out a scientific procedure.	3.1	(0.3)	6.3	(0.1)	6.8	(0.1)
Below 1b (below 260.54)	PISA 2015 does not define the competencies and skills of those scoring below Level 1b.	0.4	(0.1)	1.1	(0.0)	1.3	0

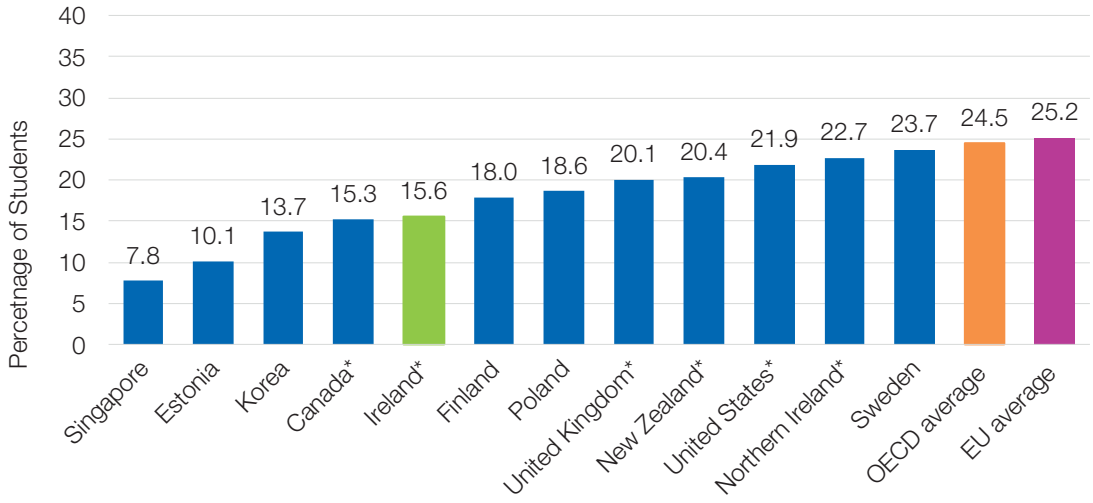
Source: Adapted from OECD 2019a, Table 4.11 and OECD 2023c, Table I.B1.3.3. See E-Appendix 5.2 and 5.3.

In Ireland, 15.6% of all participants performed below Level 2, with the majority of these (12.1%) performing at Level 1a. Students performing at Level 1a are likely to use basic or everyday content and procedural knowledge to recognise or identify explanations of simple scientific phenomena. In contrast, 24.5% of students performed below Level 2 on average across OECD countries. This is significantly higher than the percentage in Ireland (See E-Appendix Table 5.3). Eight other countries/economies had a lower proportion of students performing below Level 2 than Ireland. One in four students (25.2%) were in the lower-achieving category across the EU countries.

Figure 5.4 examines the percentages of students performing below Level 2 among the comparator countries. Sweden had the highest percentage of students (23.7%) of the comparison countries performing below proficiency Level 2. In contrast, Singapore had the lowest percentage at this level with 7.8% of students classified in this category, about half the percentage found in Ireland.

Seven of the 11 comparator countries had a greater proportion of students performing in the below Level 2 category than Ireland; they are Finland (18.0%), Poland (18.6%), United Kingdom (20.1%), New Zealand (20.4%), United States (21.9%), Northern Ireland (22.7%), and Sweden(23.7%). Canada had similar percentages of lower-achieving students to Ireland, while Korea, Estonia and Singapore had fewer.

Figure 5.4. Percentages of students performing below Proficiency Level 2 on the science scale in Ireland, in selected comparison countries, and on average across OECD and EU countries

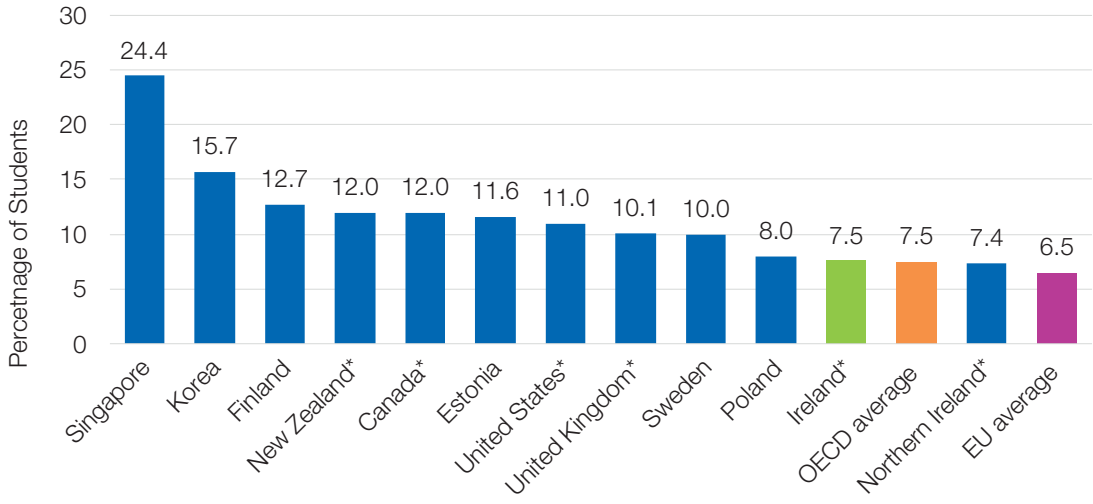


Source: Adapted from OECD 2023c, Table I.B1.5.3.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

Looking at the highest achieving group (at Levels 5 and 6), Ireland had 7.5% of students in this category, similar to the mean across all OECD countries (7.5%). Twenty-two countries/economies had greater proportions of top-performing students than Ireland (OECD 2023c, Table B1.3.3). Slightly lower average values were obtained for EU countries, where 6.5% of students are classified as high achievers.

Singapore has the greatest proportion of high achievers amongst all countries, with almost one in four students performing at this level. Among the comparator countries, students in Ireland (7.5%) and Northern Ireland (7.4%) had the lowest percentages of students in this group (Figure 5.5). Ten of the 11 comparator countries had greater proportions of high achievers than Ireland. However, the percentage of students in Ireland at Levels 5-6 is in line with values obtained for the OECD (7.5%), and EU averages (6.5%).

Figure 5.5. Percentages of students performing at or above Proficiency Level 5 on the science scale in Ireland, in selected comparison countries, and on average across OECD and EU countries



Source: Adapted from OECD 2023c, Table I.B1.5.3.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.

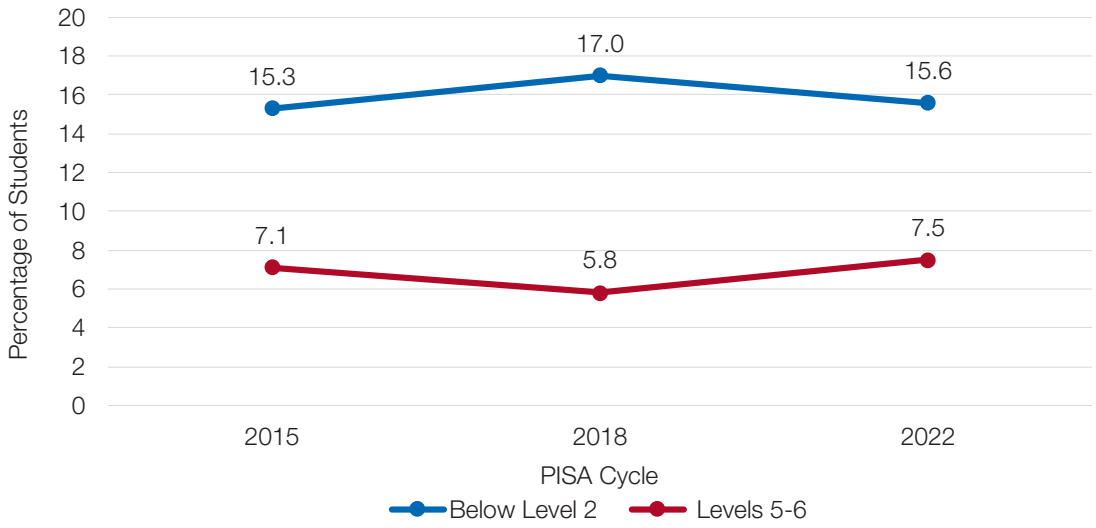
5.3.1 Trends in science proficiency levels

This section looks at trends in science proficiency levels. As with all trend analysis for Ireland, differences between PISA cycles should be interpreted with consideration of the known bias that is present in the 2022 estimates.

When science proficiency levels over the time period 2015 to 2022 were investigated, the percentages of students in Ireland below Level 2 varied slightly over three cycles, from 2015 (15.3%), to 2018 (17.0%) and 2022 (15.6%) (Figure 5.6). The decrease in proportions of students at this level between 2018 and 2022, 1.5 percentage points, was not statistically significant. On average across OECD countries, the percentage performing below Level 2 in 2022 (23.8%) is significantly higher than in 2018 (21.9%), but is similar to the percentage performing at this level in 2015 (22.1%).

The percentages of high-achieving students in Ireland in 2015 (7.1%), 2018 (5.8%) and 2022 (7.5%) varied slightly across the three cycles (Figure 5.6), although the difference of 1.7% between 2018 and 2022 is statistically significant. Across the OECD countries participating, 7.7% of PISA students performed at Level 5 or above in 2022 compared with 6.9% in 2018 (which was a significant difference), and 7.5% in 2015.

Figure 5.6. Percentage of students below Proficiency Level 2 and at or above Proficiency Level 5 on overall science in Ireland, 2015-2022



Source: OECD 2023c, Table I.B1.5.3.

5.4 Performance by Selected Variables

Student performance on science literacy was examined with reference to selected background variables: student gender, student socio-economic status, immigration status, school gender composition, and school DEIS status.

5.4.1 Science performance by gender

The mean scores for male and female students in science are examined in Table 5.4. Male students in Ireland achieved a mean score of 506.6, while females achieved a mean score of 501.0. The difference of

5.6 score points was not significant. The overall average across OECD countries was 484.6. When broken down into mean scores for male and female students, the averages were very similar (484.6 and 484.7 respectively). Males and females in Ireland achieved mean science scores that are higher than those of their OECD peers, and the difference was larger for males (21.9 points) than for females (16.3 points).

Looking at the comparison countries, Finland had the largest gender gap for science, with female students scoring on average 21.6 score points higher than male students (this is statistically significant). Sweden showed a similar trend with females significantly outperforming males (by 8.4 points). In contrast, male students in United Kingdom and Singapore significantly outscored female students by 8.1 and 6.9 points, respectively. While male students in Northern Ireland scored higher than females, the difference of 6.3 points was not significant.

Table 5.4. Gender differences on the science scale in Ireland, in selected comparison countries/ economies and on average across OECD countries

	Males		Females		Difference (males-females)	
	Mean	SE	Mean	SE	Score diff.	SED
Singapore	564.8	(1.9)	557.9	(1.9)	**6.9**	(2.8)
Korea	526.2	(5.2)	529.6	(3.8)	-3.4	(5.7)
Estonia	524.1	(2.3)	527.7	(2.6)	-3.6	(2.5)
Canada*	515.3	(2.4)	514.8	(2.1)	0.5	(2.3)
Ireland*	506.6	(3.0)	501.0	(3.0)	5.6	(4.1)
Northern Ireland*	491.7	(4.6)	485.3	(3.9)	6.3	(5.4)
United Kingdom*	503.7	(3.1)	495.5	(3.1)	**8.1**	(4.0)
New Zealand*	503.6	(3.1)	504.4	(2.9)	-0.8	(4.0)
United States*	502.7	(5.2)	495.8	(4.3)	6.9	(4.1)
Finland	500.4	(3.0)	522.0	(2.6)	**-21.6**	(2.7)
Poland	498.3	(3.1)	500.0	(3.1)	-1.7	(3.5)
Sweden	489.4	(3.1)	497.8	(2.6)	**-8.4**	(3.2)
OECD average	484.6	(0.6)	484.7	(0.5)	0.0	(0.6)

Source: OECD 2023c, Tables I.B1.5.44, I.B1.5.45 and I.B1.5.46. Table I.B2.32 is the source of NI data.
*Data for this country are accompanied by an annotation, see the forthcoming PISA 2022 Technical Report for more details.
Significant differences are in **bold**.

Gender differences in achievement can also be examined with reference to proficiency levels (Figure 5.7). Similar percentages of male students (16.1%) and female students (15.0%) in Ireland performed below the baseline level of proficiency in science (i.e. Level 2) with a non-significant difference of 1.2% between them (OECD 2023c, Table I.B1.4.33). A significantly greater percentage of male students in Ireland (9.5%) performed at Levels 5-6 compared to females (5.5%). A similar pattern is observed on average at the OECD level, although the gender differences are statistically significant among both the lower- and top-performing students.

Ireland has much fewer male and female students performing below baseline proficiency in science (16.1% and 15.0%, respectively) compared to the average across OECD countries (25.5% and 23.4%, respectively). On the other hand, the percentages of male students in Ireland performing at Level 5 or above (9.5%) is just slightly above the corresponding percentage at the OECD average (8.3%), while the corresponding percentage for female students in Ireland is slightly below the OECD average (5.5% and 6.6%, respectively).

Figure 5.7. Percentages of male and female students achieving below Proficiency Level 2 and at or above Proficiency Level 5 on the science scale, in Ireland and on average across OECD countries

Source: OECD 2023c, Table I.B1.4.33.

5.4.2 Trends in science performance by gender

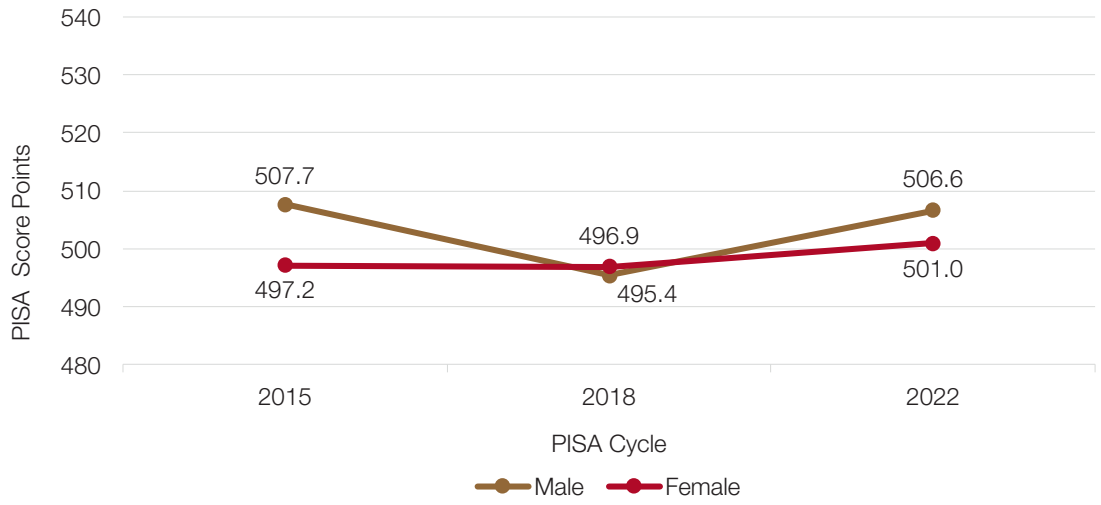
This section examines trends in performance by gender. As with all trend analysis for Ireland, differences between PISA cycles should be interpreted with consideration of the known bias in the 2022 estimates. Of students participating in PISA 2022 in Ireland, 48.7% of students were female, while 51.3% were male (weighted percentages). The average score for male students in 2022 (506.6) is significantly higher than the corresponding score in 2018 (495.4) but does not differ significantly from the mean score for males in 2015 (507.7) (Figure 5.8).

During the same period, the overall trend for female students appeared more stable with similar values for 2015 and 2018, and a non-significant increase in the mean scores of female students from 496.9 to 501.0 from 2018 to 2022.

The mean science score gap between male and female students in 2015 was a significant 10.5 score points in favour of males, but this reduced to a non-significant 5.6 points in 2022 (OECD 2023c, Table I.B1.5.46).

Across OECD countries, there was a significant decrease of 3.8 mean score points for males when compared to female students between 2015 and 2022.

Figure 5.8 Mean scores of male and female students on overall science in Ireland, 2015 to 2022



Source: OECD 2023c, Tables I.B1.5.44, I.B1.5.45 and I.B1.5.46.

Gender differences in achievement can also be reviewed across cycles with reference to proficiency levels. Table 5.5 describes the percentages of males and females below Level 2, and at or above Level 5 in Ireland in science across three PISA cycles: 2015, 2018 and 2022.

The proportion of male students in Ireland performing below Level 2 in science was relatively stable between the 2015 and 2022 cycles (15.7% and 16.1% respectively) with an increase of a non-significant 0.4 percentage points in this category. Similarly, for female students there was relative stability, with non-significant changes from 14.9% in 2015, to 16.0% in 2018, and to 15.0% in 2022.

On the other end of the performance distribution, the percentage of male students performing at or above Level 5 in science again remained relatively stable between 2015, 2018 and 2022 (9.0%, 6.8% and 9.5% respectively), all differences were non-significant. The percentage of female students performing at or above Level 5 decreased very slightly and non-significantly between 2015 and 2018 (from 5.0% to 4.9%) before increasing slightly in 2022 to 5.5%.

Table 5.5. Percentage of male and female students below Proficiency Level 2 and at or above Proficiency Level 5 on science in Ireland, 2015, 2018, 2022

	Below Level 2				At or above Level 5			
	Male		Female		Male		Female	
	%	SE	%	SE	%	SE	%	SE
2012	15.7	(1.2)	14.9	(1.1)	9.0	(0.8)	5.0	(0.5)
2018	18.1	(1.2)	16.0	(1.1)	6.8	(0.8)	4.9	(0.6)
2022	16.1	(1.2)	15.0	(1.1)	9.5	(0.8)	5.5	(0.6)
	Diff		Diff		Diff		Diff	
2022-2012	0.4		0.0		0.5		0.5	
2022-2018	-1.9		-1.1		2.7		0.6	

5.4.3 Science performance by students' Economic, Social and Cultural Status (ESCS)

PISA's measure of students' Economic, Social and Cultural Status (ESCS) is a proxy measure for student socioeconomic status with higher scores indicating a higher socioeconomic status. The ESCS index is set to have a mean of zero and a standard deviation of one, across all OECD countries. Ireland's average ESCS score is 0.33, which is significantly higher than the OECD average (0.00). Eleven percent of the variance in science performance in Ireland is accounted for by ESCS, while a one-unit (i.e., one standard deviation) increase in the ESCS scale is associated with an increase in science performance of 37.4 points. At the OECD average, 14.2% of the variance in science achievement is explained by ESCS and a one-unit increase is associated with an increase of 40.6 points on the science achievement scale, suggesting a slightly weaker relationship between ESCS and achievement in Ireland compared to the OECD average.

Students who have the lowest ESCS scores (i.e., those in the bottom quartile of the ESCS scale) performed significantly less well on science than all other students. The difference in performance between those in the lowest and highest categories is 78.2 points in Ireland (Table 5.6), which is considerably narrower than the difference at the OECD average (96.2 points).

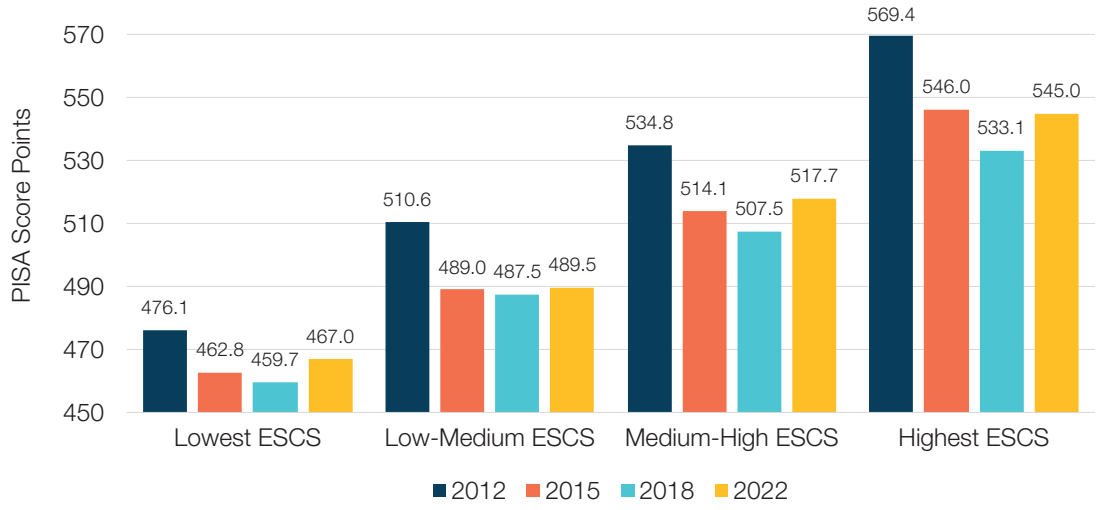
Table 5.6. Mean scores on science by ESCS quartile, in Ireland

Quartiles of ESCS	%	Mean	SE	SD
Lowest *(ref. group)*	25.0	466.8	(3.7)	88.0
Low-Medium ESCS	25.0	**489.6**	(3.5)	85.7
Medium-High ESCS	25.0	**517.7**	(2.7)	81.5
Highest	25.0	**545.0**	(3.3)	87.7

Source: OECD 2023c, Table I.B1.4.5. Significantly different mean scores are in **bold** (compared with the reference group).

As shown in Figure 5.9, the science performance of students in the bottom two quartiles of the ESCS scale (i.e., those experiencing more socioeconomic disadvantage) remained relatively stable between 2018 and 2022, while those in the top two quartiles saw significant improvements in their science performance during the same period (by 10.2 points for those in the medium-high category and by 11.9 points for those in the highest category). When looking at longer term trends over the last decade, significant declines in science performance are noted across each ESCS quartile in Ireland with the exception of the lowest category between 2012 and 2022, reflecting an overall drop in science performance that occurred in 2015 (OECD 2023c, Table I.B1.5.21).

Figure 5.9 Science performance by ESCS quartile, in Ireland from 2012 to 2022



Source: OECD 2023c, Table I.B1.5.21.

5.4.4 Student immigration status and science performance

Immigration status is a key factor associated with performance on all PISA assessments, including science. When immigration status in relation to mean science scores was looked at, a very small and non-significant difference of almost four points was observed comparing immigrant (502.6) and non-immigrant students in Ireland (506.4) (Table 5.7). On the other hand, looking at the OECD average, immigrant students achieved a significantly lower mean science score than non-immigrant students (a difference of 38.4 points).

Table 5.7. Students' mean science performance by immigration status, in Ireland and on average across OECD countries

	Non-immigrant students		Immigrant students		Difference between immigrant and non-immigrant students	
	Mean score	S.E.	Mean score	S.E.	Score dif.	SED
OECD average	492.3	(0.4)	452.9	(1.3)	**-38.4**	(1.3)
Ireland	506.4	(2.4)	502.6	(3.8)	-3.8	(4.0)

Source: OECD 2023c, Table I.B1.7.25. Significant differences are in **bold**.

5.4.5 Science performance by school sector and gender composition

Schools in Ireland can be categorised into five types based on their sector and gender composition (i.e., girls' secondary, boys' secondary, community/comprehensive, mixed secondary and vocational) and Table 5.8 presents the mean science scores of students in each school type. Students attending boys' secondary schools achieved the highest mean science score (523.2), which is significantly higher than the mean score achieved by students in ETB vocational schools. On the other hand, the mean science score of students in ETB vocational schools did not differ significantly from the scores of students in any of the other school types.

Table 5.8 Mean scores on science by school type and gender composition, in Ireland				
School type	**%**	**Mean**	**SE**	**SD**
Girls' secondary	17.8	**509.3**	(6.6)	85.8
Boys' secondary	16.5	**523.2**	(6.4)	94.7
Mixed secondary	19.1	504.3	(4.3)	87.6
Community/comprehensive	16.2	492.5	(5.8)	92.5
ETB vocational *(ref. group)*	30.4	495.9	(2.9)	92.1

Significantly different mean scores are in **bold** (compared with the reference group).

5.4.6 Science performance by DEIS status

In Ireland, 21.0% of PISA students attended DEIS schools and, on average, these students performed significantly less well on science than students in non-DEIS schools, by 39.7 points (Table 5.9). As noted in Chapter 1 a Non-Response Bias Analysis (NRBA) was carried out for Ireland due to the large decrease in the student response rate in Ireland between 2018 and 2022 (from 86% to 77%). This analysis indicated that there is an upward bias in Ireland's estimates for 2022 and that this bias is likely to be larger for students in DEIS schools than those in non-DEIS schools. This means that the difference observed between students in DEIS and non-DEIS schools in 2022 is likely to be an underestimate. In addition, the DEIS programme was extended in 2022 to include an additional 38 post-primary schools, meaning that two DEIS schools in the PISA 2022 sample were not classified as DEIS schools in 2018. Therefore, the findings by DEIS status in 2022 and comparisons of these subgroups with previous cycles should be interpreted with a high degree of caution.

Table 5.9 Mean scores on science by DEIS status, in Ireland				
DEIS Status	**%**	**Mean**	**SE**	**SD**
DEIS	21.0	**472.5**	4.9	78.4
Non-DEIS *(ref. group)*	79.0	512.2	2.3	78.3

Significantly different mean scores are in **bold** (compared with the reference group). .

5.5 Summary

This chapter described Ireland's performance in science in PISA 2022 in detail, when science was a minor assessment domain. The science framework has remained unchanged since the 2015 cycle, when science was last assessed as the major domain.

The mean science score of students in Ireland on PISA 2022 is 503.8 and is significantly higher than the OECD average of 484.6. When a 95% confidence interval is applied, Ireland's mean score ranks between 8th and 25th among all participating countries and economies, and between 5th and 20th among OECD countries. Ireland is among 24 countries with a mean science score above the OECD average, these include United Kingdom, Canada, and United States.

Ireland's mean science performance remained relatively stable between 2015 and 2018, with a non-significant decline of just over six points, but saw a significant improvement (of close to eight score points) between years 2018 to 2022. On average across OECD countries, mean science performance declined significantly across the same timeframe (a difference of 4.0 points between 2015 and 2022).

PISA describes science performance in terms of seven proficiency levels. These levels can be used to indicate what proportion of students are reaching the baseline level of proficiency (Level 2) needed to participate fully in society, and those that are attaining the highest levels (Levels 5 and 6). In Ireland, 15.6% of all students performed below Level 2 in 2022. Seven of the 11 comparator countries had a greater proportion of students performing below the baseline level than Ireland. While one comparator country had a similar percentage of low-achieving students to Ireland, another three comparator countries had fewer students in this category. At the other end of the performance scale, in Ireland 7.5% of students performed at Levels 5-6, which is similar to the average across OECD countries of 7.5% and slightly higher than the EU average (6.5%).

When science proficiency levels over the time period 2015 to 2022 were investigated, the percentages of students in Ireland performing below Level 2 varied slightly over the three cycles. The percentages of higher achieving students in Ireland between 2015 and 2022 varied only slightly across the three cycles (7.1%, 5.8% and 7.5%), with a significant improvement between 2018 and 2022.

Male students in Ireland outperformed female students in science in PISA 2022 by 5.6 score points, however, this difference was non-significant (506.6 and 501.0 respectively). When trends over time were looked at, male students showed a significant improvement in science of 11.2 score points between 2018 and 2022, while female students had a non-significant increase in their average performance of just over four score points. The mean score of females was very similar across all three cycles of PISA 2015, 2018, 2022 (497.2, 496.6 and 501.0 respectively).

Taking students Economic Social and Cultural Status (ESCS, a proxy measure for socioeconomic status) into consideration, students in the bottom quartile of the ESCS scale performed significantly less well on science than all other students. The difference in performance between those in the bottom and top quartile is 78.2 points in Ireland, and this is considerably narrower than the difference at the OECD average (96.2 points).

When immigration status was looked at in Ireland, a mean science score difference of 3.8 points was found in favour of non-immigrant over immigrant students. This difference was not statistically significant. A significantly larger 38.4-point gap in favour of non-immigrant students was evident for the OECD average.

Students attending boys' secondary schools achieved the highest mean science score (523.2) compared to those attending other school types. The mean science score of students in ETB vocational schools was significantly lower than the mean score of students attending boys' secondary schools but did not differ significantly from the score of students in any of the other school types.

In Ireland, just over a fifth of PISA students attended DEIS schools and, on average, these students performed significantly less well on science than students in non-DEIS schools, by 39.7 points.

Chapter 6: PISA Students' Reported Experiences of Learning during COVID-19

Key Points from Chapter 6

- **During school closures, students in Ireland received a relatively high level of school supports, such as learning materials, assignments, and virtual classes on a daily basis when compared with students across the OECD.**
- **Across a range of problems associated with remote learning, including online access, students in Ireland mainly faced a relatively low level of challenges, largely on a par with their OECD peers. However, a larger proportion of students in Ireland faced daily challenges linked to self-motivation.**
- **Student feelings about learning remotely were mixed, with over half enjoying and feeling well-prepared to learn on their own, but higher than average numbers reported feeling lonely and missing extra-curricular activities, as well as having challenges with self-motivation.**

As outlined in Chapter 1, Ireland was conducting the Field Trial for PISA 2022,[38] when the outbreak of COVID-19 was declared to be a pandemic by the World Health Organisation in March 2020. Shortly afterwards, all schools in Ireland were closed in order to help contain the spread of the virus. The following academic years (2020-21 and 2021-22) were marked by varying and changing levels of school closures and COVID-19 restrictions, until all restrictions in schools were ultimately lifted in February 2022.[39]

Through a series of questionnaires, PISA collects background information from students, parents, school principals and teachers across student background constructs, schooling constructs and non-cognitive/metacognitive constructs. In response to unprecedented disruption to schooling globally, PISA added a Global Crises Module (GCM) to the Student and School questionnaires in PISA 2022 to gather information on the effect of the pandemic on teaching, learning, and on students' lives. The GCM in the student questionnaire asked questions relating to the school closures, covering topics such as supports provided by school and family, access to technology to support learning, learning resources used, obstacles to remote learning, and their own perceptions of and feelings about learning on their own. School principals were asked questions about how learning was organised during school closures, resources provided to students, obstacles to remote teaching, teachers' duties, and student attendance. Further detail on the PISA 2022 questionnaire framework

[38] The Main Study for the eighth cycle of PISA was originally scheduled to take place in 2021 but was postponed by one-year due to the COVID-19 pandemic.

[39] See Box 1.2 in Chapter 1 for a detailed timeline of school closures in Ireland during the pandemic.

is available in the *PISA 2022 Assessment and Analytic Framework* (OECD, 2023a) and the PISA 2022 Technical Report (OECD, in press).

This chapter first gives a brief overview of the main findings from other International Large-Scale Assessments (ILSAs) about student learning during school closures as a result of the COVID-19 pandemic. Following this, key findings from PISA 2022 students' reports of their experiences of learning during the pandemic are presented across key areas including school and family supports, self-evaluation of their own learning, as well as perceived self-efficacy. Data from the GCM for Ireland will be explored in further detail in follow-up national reporting, expected to be published in 2024.

6.1 Findings from other International Large-Scale Assessments (ILSAs)

6.1.1 Response to Educational Disruption Survey (REDS)

The Response to Educational Disruption Survey (REDS) was a joint study of the IEA, UNESCO and the European Commission investigating the influence of the COVID-19 pandemic on education worldwide. Published in 2022 (Meinck et al., 2022), REDS examined continuity of learning at Grade 8 in twelve countries, with data collected from governments, principals, and (optionally) teachers and students. Ireland did not take part in REDS.

The study found that many education systems and schools were inadequately prepared for sudden changes brought about by significant school closures. All participating countries reported at least one period of physical school closure due to the COVID-19 pandemic, with significant variation in the timing and duration of closures. The level of teaching and learning provision during closures varied with countries with higher Human Development Index[40] scores offering greater provision.

More than 50% of teachers reported that students had not progressed to the normal expected level, and most felt it was challenging to provide lower-achieving and vulnerable students with the support needed. A similar proportion of students believed they learned about as much during COVID-19 disruptions. However, about half also felt it was difficult to assess how they were progressing.

Over 50% of students in the majority of countries felt overwhelmed by the pandemic, and anxious about their education, and many did not feel very prepared or not prepared at all for a similar scenario in future. However, most felt supported. Students from lower socio-economic backgrounds were less confident about completing school work independently, and were more likely to worry about their future education and falling behind in learning (Stancel-Piątak et al., 2022).

6.1.2 PIRLS 2021

The Progress in International Reading Literacy Study (PIRLS) is implemented every five years to assess the reading literacy of Fourth grade pupils internationally. Schools, pupils and teachers who took part in the PIRLS 2021 study were asked questions about their experience of school closures due to COVID-19.

[40] The United Nations Human Development Index (HDI) is a composite measure of three aspects of human development: a long and healthy life, being knowledgeable, and having a decent standard of living. (United Nations Development Programme, [UNDP] 2021).

Internationally, across all PIRLS 2021 countries on average, 86 % of pupils attended schools that were affected by closures due to the COVID-19 pandemic during the 2020-2021 school year, with 47% of these in schools that were affected for 'more than 8 weeks' of instruction. Parents of pupils reported that their child's learning was adversely affected to varying degrees with parents of 22% of pupils reporting that learning was affected 'a lot', compared to 45% for 'somewhat' and 19% 'not at all' (Mullis et al., 2023).

In Ireland, PIRLS 2021 took place in autumn 2021 at the start of Grade 5 (Fifth Class). Pupils in the Irish sample experienced school closures from mid-March 2020 until the end of the school year, and from January until mid-April 2021. The vast majority of pupils in Ireland had principals who reported that their schools provided the following resources to students to support remote learning when normal operations were affected by the pandemic: delivery of printed learning materials to pupils (88%); Internet-based resources for pupils (99%); access to digital devices for pupils (85%); recommendations for teachers about how to provide online instruction (98%); technical support for teachers (85%); access to digital devices for teachers (96%); a whole-school policy on remote learning (90%); recommendations for parents about how to support pupils' engagement with remote learning (97%).

Similarly, most parents reported that their child's school provided resources to support remote learning, including reading assignments (74%); online activities (94%); and printed learning materials (56%). Parents also reported providing additional educational resources themselves, mainly books (82%) and digital devices (82%), but also digitally-based learning activities (70%), and online instruction or tutoring (50%). Further, 58% of parents reported that their child's learning progress was somewhat negatively affected by school closures, with another 17% reporting that learning progress was negatively affected.

The majority of pupils (59%) were taught by teachers who reported that the literacy development of between a quarter and a half of the class was negatively affected since the beginning of the COVID-19 pandemic. The teachers of 58% of pupils reported that the class was involved in a wellbeing initiative to address the possible impact of the COVID-19 pandemic on pupils, with lower levels reporting involvement in initiatives related to: social interaction and engagement (32%); physical education (37%); literacy (32%); numeracy (30%); other academic areas (20%).

Despite these findings, it should be noted that the overall results for PIRLS 2021 in Ireland showed no decrease in achievement, and in fact showed a significant increase in mean reading achievement, though caution is needed in interpreting these findings given the unusual circumstances in which the study was implemented (see Section 2.1.5 in Chapter 2 for more details) (Delaney et al., 2023).

6.2 Learning and Learning Support during School Closures

With a mixed picture being reported internationally in relation to school closures and how teaching and learning was delivered during the COVID-19 pandemic, what follows is an examination of the situation in Ireland using data from PISA 2022. This section examines the experience of students in Ireland in more detail using data gathered through the GCM of the student and school questionnaires of PISA 2022. A brief overview of school closures in Ireland is presented, followed by an outline of the contents of the GCM. Subsequently, supports received by students from their school and family members will be examined, followed by an analysis of some of the problems encountered

by students with remote learning. Finally, students' feelings about learning on their own and their perceptions of their learning in this context are considered.

6.2.1 PISA 2022 Global Crises Module

In Chapter 1, the disruptions associated with COVID-19 during the PISA 2022 Field Trial and Main Study were outlined in detail. In Ireland, the first national lockdown due to the COVID-19 pandemic began on 13th March 2020, and included full closure of all schools for in-person learning. School closures continued until the end of the school year. A second period of school closures was in effect from the beginning of 2021 and was ended with a phased return to in-person learning. The final group of students to return to school (which included most of the PISA 2022 cohort) did so on 12th April 2021.

In response to the disruption to learning that resulted from the COVID-19 pandemic, the PISA consortium developed a series of questions asking about students' and principals' experiences during the pandemic. PISA 2022 included a GCM, which consisted of a series of questions incorporated into the questionnaires for students, and school principals around the impact of the COVID-19 pandemic on teaching and learning, in addition to the regular components of these questionnaires.

The Student Questionnaire GCM collected information on topics such as the duration of closures, devices and materials used for learning, as well as problems encountered, and also students' reported feelings about their experience of learning on their own and their perception of their performance. School principals were asked among other things, about actions and activities carried out to maintain learning, and monitoring of students' attendance.

The GCM provides a wealth of information related to this unique and challenging period in these students' lives. This will allow, among other analyses, an exploration of students' experiences across different background characteristics, and an investigation into the extent aspects of these experiences interacted with performance across the cognitive domains.

6.2.2 Actions to support teaching and learning during COVID-19

As part of the School Questionnaire GCM, school principals were asked a number of questions about how instruction was organised in their school when the building was closed to students because of COVID-19. In Ireland, all students attended a school where the principal reported that at least half of classes were taught remotely using digital devices, and 80.2% of these students attended a school where the principal reported that *all or almost all of the classes* were taught remotely using digital devices. Principals were also asked about how many classes were cancelled and not replaced by remote instruction. In Ireland, 7.9% of students attended schools where the principal reported that *half of classes or fewer* were cancelled and not replaced by remote instruction while no student attended a school where the principal reported where this was the case in more than half of classes.

The GCM within the Student Questionnaire presented students with a list of school supports and asked them to indicate how often someone from their school did each of those things during COVID-19 related school closures (Table 6.1). Almost half of students in Ireland (48.7%) reported that someone 'sent them learning materials to study on their own' *every day or almost every day*, compared to just under one-third of students on average across the OECD (32.6%). In Ireland, 71.6% of students reported that someone from their school 'sent them specific assignments', while a similar percentage reported that someone 'uploaded material on a learning-management system or school learning platform' (70.4%), and 'offered live virtual classes on a video communication programme' (69.5%) *every day*. In comparison, about half of students across the OECD reported that someone

from their school 'sent them specific assignments' (45.4%), 'uploaded material on a learning-management system or school learning platform' (46.0%) and 'offered live virtual classes on a video communication program' (50.6%) *every day or almost every day*. These findings indicate that students in Ireland received a noticeably higher level of contact and continuity of instruction from their school than was typical across OECD countries on average.

However, when asked how often someone from their school 'checked in with them to ask how they were feeling,' just 8.6% of students in Ireland indicated that this happened, *every day or almost every day*, compared to 13.3% of students across the OECD.

Table 6.1: Percentage of students who reported that someone from their school did the following *every day or almost every day* when their school building was closed because of COVID-19:

	Ireland		OECD Average	
	%	S.E.	%	S.E.
Sent them learning materials to study on their own	48.7	(1.0)	32.6	(0.2)
Sent them assignments	71.6	(1.1)	45.4	(0.2)
Uploaded material on a learning-management system or school learning platform	70.4	(1.2)	46.0	(0.2)
Checked in with them to ensure that they were completing their assignments	38.5	(1.0)	23.7	(0.2)
Offered live virtual classes on a video communication program	69.5	(1.0)	50.6	(0.2)
Asked them to submit completed school assignments	64.6	(1.0)	40.0	(0.2)
Gave them helpful tips about how to study on their own	19.1	(0.9)	17.1	(0.1)
Checked in with them to ask how they were feeling	8.6	(0.5)	13.3	(0.1)

Source: OECD 2023d, Table II.B1.2.23.

A composite index of school actions and activities to maintain learning was created based on students' reports with a mean score of about 0.0 and a standard deviation of 1 across OECD countries. The mean score for Ireland was 0.42 which is considerably above the OECD average (-0.01), indicating a higher level of school actions and activities to maintain learning when school buildings were closed because of COVID-19 in Ireland compared to the average for OECD countries (OECD 2023d, Table II.B1.2.23, see E-Appendix Table 6.1).

6.3 Students' Perspectives on Learning during the Pandemic

The GCM asked students for their perspective on the experience of learning during the COVID-19 pandemic. This section looks first at students' reports of the supports they received for learning during this time, and investigates what barriers they encountered, before reporting on students' feelings about their learning experiences during this time.

6.3.1 Supports for learning

Students were asked to report the extent to which they received various different supports for their learning from someone in their family, ranging from *never* to *every day or almost every day*. Across a number of these supports, which include 'help them with their homework', 'help them access learning materials online' and 'explain new content to them', the frequencies with which students in Ireland

received help from a family member were broadly similar to the reports of students on average across the OECD.

The percentages of students who reported that a family member 'asked them what they were learning', and 'checked whether they were completing their school assignments' *every day or almost every day* were slightly higher in Ireland than across the OECD on average (24.2% compared to 22.3%, and 21.7% compared to 19.7% respectively). These two supports showed the highest levels in the category *every day or almost every day* of the eight family supports listed, both among students in Ireland and students across the OECD, suggesting the focus of family support in relation to learning was more oriented towards monitoring than tuition.

In Ireland 57.1% of students reported that they *never* received help from someone in their family to create a learning schedule, compared to 45.5% of students on average across OECD countries (Table 6.2). However, this may be linked to the relatively high degree to which classes were completed online in Ireland during pandemic-related school closures. There was also a higher proportion of students in Ireland (43.5%) who reported that they *never* received help from a family member to find additional learning resources, compared to 36.2% of students across the OECD. This difference may be related to the higher levels of learning materials provided by schools to students in Ireland.

Table 6.2. Percentage of students reporting that, when their school building was closed because of COVID-19, someone in their family did the following things with them *every day/almost every day* or *never*:

	Every day or almost every day				Never			
	Ireland		OECD Average		Ireland		OECD Average	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.
Help them with their school work	10.7	(0.6)	11.7	(0.1)	20.7	(0.8)	22.6	(0.2)
Ask them what they were learning	24.2	(0.8)	22.3	(0.2)	12.4	(0.6)	14.5	(0.1)
Help them create a learning schedule	6.4	(0.5)	9.7	(0.1)	57.1	(1.1)	45.5	(0.2)
Help them access learning materials on line	11.6	(0.5)	12.7	(0.1)	32.8	(1.0)	33.8	(0.2)
Check whether they were completing their school assignments	21.7	(0.8)	19.7	(0.1)	18.4	(0.9)	22.9	(0.2)
Explain new content to them	9.6	(0.5)	10.4	(0.1)	38.1	(1.0)	36.8	(0.2)
Help them find additional learning resources	9.2	(0.5)	11.5	(0.1)	43.5	(1.1)	36.2	(0.2)
Teach them additional topics not part of their school assignments	8.7	(0.6)	10.5	(0.1)	49.3	(1.1)	41.3	(0.2)

6.3.2 Challenges and obstacles to self-learning

In addition to being asked about the supports they received from their school and family, students were also questioned about some of the challenges and obstacles they may have faced when learning remotely. Students were presented with a list of problems related to completing their schoolwork and asked how often they had experienced these problems during school closures. Table 6.3 shows that a relatively low proportion of students in Ireland and on average across the OECD experienced daily problems with access to a digital device when needed (3.5% and 4.7%, respectively), and with Internet access (5.6% and 6.0%, respectively), suggesting access to technology was not a regular issue for most of these students. Most of the other listed problems, including finding a quiet place to study, understanding school assignments and finding someone who could help them with their schoolwork, were only experienced daily by a low percentages of students in Ireland, on a par with their international peers.

However, a somewhat higher proportion of students in Ireland (36.4%) said they experienced problems *every day or almost every day* with motivating themselves to do school work compared to the OECD average (24.8%). Similarly, a noticeably smaller proportion of students in Ireland than students on average across the OECD reported that they *never* experienced problems with motivating themselves to do school work (11.4% compared to 20.3% across the OECD). See E-Appendix 6.2 for full data on this question.

Table 6.3. Percentage of students reporting that when their school building was closed because of COVID-19 they had the following problems *every day or almost every day* when completing their school work:

	Ireland		OECD Average	
	%	S.E.	%	S.E.
Problems with access to a digital device when they needed it	**3.5**	**(0.3)**	**4.7**	**(0.1)**
Problems with Internet access	**5.6**	**(0.5)**	**6.0**	**(0.1)**
Problems with access to school supplies	**2.1**	**(0.3)**	**3.0**	**(0.1)**
Problems with finding a quiet place to study	**8.8**	**(0.6)**	**6.7**	**(0.1)**
Problems with finding time to study because they had household responsibilities	**7.2**	**(0.4)**	**5.4**	**(0.1)**
Problems with motivating themselves to do school work	**36.4**	**(0.9)**	**24.8**	**(0.2)**
Problems with understanding their school assignments	**12.5**	**(0.6)**	**11.0**	**(0.1)**
Problems with finding someone who could help them with their schoolwork	**10.3**	**(0.5)**	**9.0**	**(0.1)**

Source: OECD 2023d, Table II.B1.2.17.

A composite index based on the statements was developed with a mean score of about 0.0 and a standard deviation of 1 across OECD countries. The mean score for Ireland was 0.12 compared to -0.01 for the OECD on average, indicating the reported extent of these problems overall among students in Ireland was slightly higher than among students across the OECD (OECD 2023d, Table II.B1.2.17, see E-Appendix Table 6.2). This difference seems to be largely influenced by the elevated scores on problems with self-motivation among students in Ireland.

6.3.3 Student feelings about learning in the pandemic

When the COVID-19 pandemic began, students and teachers experienced a sudden and dramatic shift in their experience of teaching and learning, with schools closing with little prior warning. Students transitioned from communal in-person learning experience to a remote, more solitary mode

of learning. With limited social outlets outside of the virtual environment, this undoubtedly presented emotional challenges to students who were required to adjust quickly to this radically different lifestyle. This section examines students' feelings about that experience, and their perceptions of their own learning in this time.

Students were asked to indicate to what extent they agreed or disagreed with ten statements about how they felt about the time when their school building was closed because of COVID-19 (Table 6.4). Students in Ireland and on average across the OECD had similar levels of agreement with some of the statements, with over half of students in both groups either *agreeing or strongly agreeing* that 'I enjoyed learning by myself' (52.5% in Ireland and 54.9% on average across OECD countries). Similarly, over 40% of students in both groups *agreed or strongly agreed* that 'I felt anxious about school work' (43.2% in Ireland and 46.6% at the OECD average). In spite of this there was a higher proportion of students in Ireland (19.2%) who *strongly agreed* that 'I fell behind in my school work,' compared to 13.1% of OECD students. Consistent with previous findings (see Table 6.3), there was a considerably higher level of *disagreement* with the statement 'I was motivated to learn' among students in Ireland with 74.3% *disagreeing* or *strongly disagreeing*. This compares to 61.5% of students across the OECD.

Over 40% of students in Ireland *agreed* or *strongly agreed* that they felt lonely (43.7%), which is higher than the 38.3% of students across the OECD. In a similar vein, a substantially higher percentage of students in Ireland (70.9%) *agreed* or *strongly agreed* that they 'missed sports and other physical activities organised by my school' compared to 57.0% of OECD students.

While overall levels of agreement with the statement 'my teachers were available for me when I needed help' were similar among students in Ireland and across the OECD (67.7% compared to 67.1%), a higher proportion of students across the OECD on average (12.0%) *strongly agreed* with that statement than students did in Ireland (7.3%).

Table 6.4. Percentage of students reporting the following about the time when their school building was closed because of COVID-19.

		Strongly disagree		Disagree		Agree		Strongly agree	
		%	S.E.	%	S.E.	%	S.E.	%	S.E.
I felt lonely	OECD average	27.6	(0.2)	34.2	(0.2)	26.8	(0.2)	11.5	(0.1)
	Ireland	18.2	(0.9)	38.1	(0.9)	32.6	(1.0)	11.2	(0.7)
I enjoyed learning by myself	OECD average	15.6	(0.1)	29.5	(0.2)	41.2	(0.2)	13.8	(0.1)
	Ireland	15.4	(0.7)	32.0	(0.9)	41.4	(1.0)	11.1	(0.8)
My teachers were available when I needed help	OECD average	10.9	(0.1)	22.0	(0.2)	55.0	(0.2)	12.0	(0.1)
	Ireland	9.7	(0.7)	22.5	(0.9)	60.4	(1.0)	7.3	(0.5)
I felt anxious about school work	OECD average	18.4	(0.2)	35.0	(0.2)	33.3	(0.2)	13.3	(0.1)
	Ireland	14.5	(0.7)	42.3	(1.1)	31.3	(1.1)	11.9	(0.7)
I was motivated to learn	OECD average	22.1	(0.2)	39.4	(0.2)	31.4	(0.2)	7.1	(0.1)
	Ireland	28.6	(1.0)	45.6	(1.1)	22.4	(0.9)	3.3	(0.3)
I fell behind in my school work	OECD average	16.5	(0.2)	35.9	(0.2)	34.5	(0.2)	13.1	(0.1)
	Ireland	8.6	(0.6)	34.2	(1.0)	38.0	(1.1)	19.2	(0.9)
I improved my skills in using digital devices for learning purposes	OECD average	11.8	(0.1)	25.2	(0.2)	49.7	(0.2)	13.3	(0.1)
	Ireland	10.3	(0.6)	27.0	(0.8)	53.6	(1.0)	9.1	(0.6)
My teachers were well prepared to provide instruction remotely	OECD average	15.9	(0.1)	33.4	(0.2)	42.1	(0.2)	8.6	(0.1)
	Ireland	12.4	(0.7)	32.5	(1.1)	48.5	(1.2)	6.6	(0.5)
I was well prepared to learn on my own	OECD average	13.5	(0.1)	32.0	(0.2)	43.5	(0.2)	11.1	(0.1)
	Ireland	13.3	(0.8)	34.5	(1.1)	44.5	(1.2)	7.8	(0.6)
I missed sports and other physical activities organised by my school	OECD average	17.8	(0.2)	25.2	(0.2)	36.0	(0.2)	21.0	(0.2)
	Ireland	9.6	(0.7)	19.5	(0.8)	40.3	(1.0)	30.6	(1.1)

Source: OECD 2023d, Table II.B1.2.11

In relation to how students viewed their learning during COVID-19 school closures relative to in-person schooling (Table 6.5), there was a somewhat more negative perception among students in Ireland, with over three-quarters (76.0%) reporting that they felt that they 'learned less when my school building was closed' compared with less than two-thirds (64.9%) of students across the OECD.

Table 6.5. Percentage of students who reported the following about their learning during COVID-19 school closures compared to a typical week when they go to school in person

	I learned less when my school building was closed		I learned about as much when my school building was closed		I learned more when my school building was closed	
	%	S.E.	%	S.E.	%	S.E.
OECD average	64.9	(0.1)	25.8	(0.1)	9.3	(0.1)
Ireland	76.0	(0.7)	17.8	(0.6)	6.2	(0.4)

Students were asked to rate their level of confidence in carrying out various self-learning actions in the event of future school closures (Table 6.6). Again, self-motivation arose as an issue for students in Ireland, with over half of students (52.0%) stating they were *not confident* about motivating themselves to do schoolwork compared to 41.9% of students across the OECD on average. Similarly, students in Ireland reported lower levels of confidence in 'focusing on schoolwork without reminders' with 42.3% feeling that they were *not confident* compared to 37.1% of OECD students. However, almost three-quarters of students in Ireland (74.8%) reported a *confidence* in 'completing schoolwork independently' which was slightly higher than the OECD average of 71.5%.

Table 6.6. Percentage of students reporting their level of confidence in taking the following actions if their school building closes again in the future.

		Motivating myself to do school work							
		Not at all confident		Not very confident		Confident		Very confident	
		%	S.E.	%	S.E.	%	S.E.	%	S.E.
Using a learning-management system or school learning platform	OECD average	10.7	(0.1)	15.4	(0.1)	43.9	(0.2)	30.0	(0.2)
	Ireland	7.1	(0.5)	12.3	(0.8)	49.8	(1.0)	30.8	(1.1)
Using a video communication program	OECD average	8.4	(0.1)	14.5	(0.1)	44.5	(0.2)	32.5	(0.2)
	Ireland	6.4	(0.4)	12.3	(0.7)	52.5	(1.0)	28.9	(0.9)
Finding learning resources online on my own	OECD average	8.1	(0.1)	19.2	(0.1)	48.7	(0.2)	24.0	(0.2)
	Ireland	7.8	(0.5)	20.1	(0.8)	52.8	(0.9)	19.3	(0.8)
Planning when to do school work on my own	OECD average	8.5	(0.1)	22.2	(0.2)	48.2	(0.2)	21.1	(0.2)
	Ireland	7.7	(0.5)	21.5	(0.9)	53.6	(1.0)	17.1	(0.7)
Motivating myself to do school work	OECD average	12.7	(0.1)	29.2	(0.2)	42.9	(0.2)	15.2	(0.1)
	Ireland	16.7	(0.7)	35.3	(0.9)	38.5	(0.9)	9.4	(0.6)
Focusing on school work without reminders	OECD average	10.4	(0.1)	26.7	(0.2)	45.3	(0.2)	17.5	(0.1)
	Ireland	12.4	(0.6)	30.0	(0.9)	45.0	(1.0)	12.7	(0.7)
Completing school work independently	OECD average	8.3	(0.1)	20.2	(0.1)	50.3	(0.2)	21.2	(0.2)
	Ireland	8.3	(0.5)	17.0	(0.8)	56.3	(1.0)	18.4	(0.8)
Assessing my progress with learning	OECD average	9.3	(0.1)	25.3	(0.2)	47.7	(0.2)	17.7	(0.1)
	Ireland	9.7	(0.5)	25.6	(0.9)	50.5	(1.0)	14.2	(0.7)

Source: OECD 2023d, Table II.B1.2.4.

Based on the students' reports of their confidence across these aspects of self-directed learning, an index of confidence in capacity for self-directed learning was constructed. This index has a mean of 0.00 and a standard deviation of 1 across OECD countries. Ireland's mean score on the index

was -0.07, which indicated that overall students in Ireland had slightly less confidence in their own capacity for self-directed learning than students on average across the OECD did (OECD 2023d, Table II.B1.2.4, see E-Appendix Table 6.3).

On a similar theme, students were asked to rate how prepared they felt about learning on their own should their school be closed again for an extended period of time (Table 6.7). The majority of students in Ireland felt *well prepared* (51.2%) or *very well prepared* (14.1%), which is comparable to the corresponding percentages across OECD countries (48.4% and 15.8%, respectively). However, almost a quarter of students in Ireland (24.0%) reported feeling *not very prepared* and 10.8% reported feeling *not prepared at all*. These figures were also comparable to OECD averages. The rate of non-response for this question in Ireland was 9.0%, which compares to a figure of 10.7% for the OECD and may be explained by a degree of response fatigue, as this question was asked towards the end of the Student Questionnaire (see E-Appendix Table 6.4).

Table 6.7. Percentage of students reporting that, overall, they feel the following about learning on their own if their school building closes again for an extended period in the future.

	Not prepared at all		Not very prepared		Well prepared		Very well prepared	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.
OECD average	9.6	(0.1)	26.2	(0.1)	48.4	(0.1)	15.8	(0.1)
Ireland	10.8	(0.5)	24.0	(0.7)	51.2	(0.7)	14.1	(0.6)

School principals were also asked about their levels of preparedness for providing remote instruction in the event of prolonged school closures in the future. No student in Ireland attended schools where the principal reported that the school was *not prepared at all* and only 2.6% attended schools where the principal reported that the school was *not very prepared* (see E-Appendix Table 6.5).

6.4 Summary

This chapter gave a brief overview of the main findings from PIRLS 2021 and REDS International Large-Scale Assessments (ILSA's) about student learning during COVID-19 related school closures. Key findings from PISA 2022 students' reports of their experience of learning during the pandemic were presented across areas including school and family supports, students' feelings about learning on their own during school closures, and self-evaluation of their own learning.

High proportions of students in Ireland reported receiving a range of supports *every day or almost every day* from their school. These supports included being sent learning materials and assignments, and offering live virtual classes, with a substantially higher proportion of students in Ireland receiving these supports daily compared to students on average across the OECD. This was consistent with school principal reports of high levels of provision of virtual classes, and low levels of class cancellation.

Students were also asked about the kind of learning supports they received from someone in their family. The supports that student in Ireland reported receiving most frequently were a family member asking about what they were learning and checking whether school assignments were being completed. Students in Ireland were less likely than their OECD counterparts to report receiving help from someone in their family to create a learning schedule or to find additional learning resources which is perhaps related to the relatively high degree of support students in Ireland reported receiving from their schools.

A small proportion of students in Ireland and across the OECD reported experiencing difficulties daily across a range of problems associated with completing their schoolwork when their school was closed, including access to a digital device, Internet access, opportunity to study and availability of help, with 10% or less of students reporting such difficulties. However, over a third of students in Ireland (36.4%) reported experiencing problems *every day or almost every day* with motivating themselves to do schoolwork compared to just under a quarter of students on average across the OECD (24.8%).

Students in Ireland reported mixed feelings about learning during the pandemic. Over half *agreed* that they enjoyed learning by themselves (52.5%) and that they were well prepared to learn on their own (52.2%), and these levels were on a par with those reported by students on average across the OECD. However, higher levels of students in Ireland *agreed* that they felt lonely (43.7% compared to 38.3% at OECD level), and that they missed sports and physical activities organised by their school (70.9% compared to 57.0%). Furthermore, a noticeably higher percentage of students in Ireland than across the OECD on average *disagreed* that they were motivated to learn (74.3% compared to 61.5%).

These findings have relevance in the context of some of the key skills of the Junior Cycle including *managing myself*, *staying well* and *managing information and thinking* (see Figure 2.4 in Chapter 2).

Chapter 7: Summary and Conclusions

This concluding chapter reviews the data presented throughout this report, and draws conclusions across four broad themes: overall performance, lower- and higher-achieving students, gender differences, and students' experiences of learning during COVID-19. The final section looks ahead to the next cycle of PISA, in 2025, when science will be the main domain.

The Programme for Student Assessment (PISA) is an initiative of the Organisation for Economic Cooperation and Development (OECD). PISA seeks to assess 15-year olds' preparedness to meet the challenges of life in today's societies (OECD 2023 in press). In PISA 2022, mathematics was the main assessment domain, while science and reading were minor domains. The Main Study of this cycle was delayed by one year as a result of disruption caused to educational systems worldwide by the COVID-19 pandemic. In PISA 2022, approximately 690,000 students participated in 81 countries/economies. In Ireland, PISA is implemented by the Educational Research Centre (ERC), on behalf of the Department of Education.

7.1 Overall Performance and Trends in PISA

Ireland's performance in PISA 2022 showed some changes when compared to previous cycles, particularly in mathematics and science. Ireland's performance needs to be interpreted with regard to wider international developments in PISA 2022, as well as with consideration of the likely upward bias in the PISA 2022 estimates for Ireland identified in Ireland's Non-Response Bias Analysis (NRBA).

7.1.1 Mathematics

As mathematics was the main domain in PISA 2022, a new framework was written for this cycle. Drawing on the framework, new mathematics items, tailored for delivery on a digital platform, were developed. PISA 2022 results for Ireland indicated that students in Ireland achieved a mean score of 491.6 in mathematics, which is significantly higher than the OECD average of 472.4. Singapore outperformed all other countries/economies in PISA mathematics, with a mean score of 574.7. Nine countries/economies achieved a mean mathematics score that is significantly higher than Ireland's (they are Singapore, Macao, Chinese Taipei, Hong Kong, Korea, Japan, Estonia, Switzerland, and Canada), while Ireland's mean mathematics performance does not differ significantly from that of eight countries/economies (Netherlands, Belgium, Denmark, Poland, United Kingdom, Czech Republic, Austria, and Australia). The remaining 63 economies performed significantly less well than Ireland in mathematics.

Ireland's mean mathematics score in 2022 is 8.0 score points lower than in the 2018 PISA cycle. This difference is statistically significant. The recorded decrease in mean mathematics achievement should be considered in the context of similar decreases internationally. In the same period (2018-2022) the OECD mean mathematics score decreased significantly by 14.9 points. Internationally, 41 countries out of 72 countries that can compare results between the 2018 and 2022 showed a drop

in mean performance in mathematics, and in many cases, the drop exceeded 20 score points (OECD 2023c, Table I.B1.5.4).

In the Irish context, the indication from the NRBA of a likely upward bias in the estimates means that there is evidence to suggest that the decrease recorded in mathematics achievement could in fact be larger if Ireland had achieved similar response rates to previous cycles of the study.

This decline in mathematics performance is a cause for concern as Ireland's mathematics performance in previous cycles of PISA (2012-2018) showed relative stability, in line with the mathematics results for the latest cycles of TIMSS in 2015 and 2019 (Perkins & Clerkin, 2020). While some caution is required in interpreting the PISA 2022 results for Ireland due to the likely upward bias in these estimates, it is noteworthy that some patterns have emerged in the data for 2022 that are consistent with the findings from previous cycles. In particular, findings related to the distribution of mathematics performance across proficiency levels and according to gender are similar to previous cycles and are discussed in more detail later in this chapter. However, the decline in overall mathematics performance warrants further investigation. The ERC plans to publish thematic follow-up reporting on Ireland's performance in mathematics, with particular emphasis on performance on content areas and process subscales. This analysis will also draw on data on attitudes to mathematics garnered in the questionnaire materials.

7.1.2 Reading

Reading literacy was assessed in PISA 2022 as a minor domain. Ireland continued to perform strongly in reading in this cycle, when students achieved a mean reading literacy score of 516.0. This exceeds the OECD average by 40 points. Just one economy, Singapore, achieved a significantly higher mean reading score than Ireland with a mean of 542.6. Four economies (Japan, Korea, Chinese Taipei, and Estonia) obtained mean scores that do not differ significantly from Ireland's, while 75 economies had mean scores that are significantly lower than Ireland's in reading.

Ireland's mean reading score in 2022 is 2.1 score points lower than in the 2018 PISA cycle, though this difference is not statistically significant. This stability of performance can be interpreted against a background of the reading results for other countries/economies participating in PISA 2022. On average, across OECD countries, performance in reading declined by a significant 10.3 score points since 2018.

While the initial picture of reading performance in Ireland appears to be that of relative stability, caution must be exercised in interpretation. The indication from the NRBA that there is a likely upward bias in the achievement estimates for Ireland means that the differences between 2018 and 2022 may be larger, and the possibility of a decline in reading performance in Ireland cannot be definitively ruled out.

Other recent assessments of reading in the Irish context such as PIRLS 2021 (Delaney et al., 2023) and NAMER (Kiniry et al., 2023) have shown encouraging results, suggesting that students in Ireland have been relatively consistent in their strong reading performance, despite the disruptions to schooling resulting from the COVID-19 pandemic. Although the results from these two studies are not directly comparable, given the differing age cohorts, they show promise for future PISA results.

7.1.3 Science

Science was also assessed as a minor domain in the PISA 2022 cycle. Students in Ireland achieved a mean PISA 2022 science score of 503.8, which is significantly higher than the OECD average of

484.6 by 19.2 score points. Nine countries/economies had a mean science score significantly higher than Ireland (they are Singapore, Japan, Macao, Chinese Taipei, Korea, Estonia, Hong Kong, Canada, and Finland). Eight were not significantly different from Ireland (Australia, New Zealand, Switzerland, Slovenia, United Kingdom, United States, Poland, and Czech Republic), and the remaining 63 countries/economies had significantly lower mean science scores than Ireland.

Ireland's mean science score in 2022 is 7.7 score points higher than in the 2018 PISA cycle, and this difference is statistically significant. This increase can be interpreted against the background of international achievement, where the OECD average recorded a non-significant drop of 2.4 score points. Science performance remained broadly stable in many countries/economies between 2018 and 2022 (33 out of 71 countries) (OECD 2023c, Table I.B1.5.4).

Although science achievement in Ireland showed significant improvement since 2018, caution must be exercised in interpretation of the scale of the improvement. The indication from the NRBA that there is a likely upward bias in the estimates means that the increase in science performance may be smaller than the estimates suggest.

The findings from recent cycles of PISA (McKeown et al., 2019) and TIMSS (Perkins and Clerkin, 2020) have shown a non-significant decline in science achievement for post-primary students in Ireland. Seen against this background, the increase in science performance in PISA 2022 results is encouraging. It is noteworthy that students in Ireland participating in PISA 2022 are the first PISA cohort to have studied Junior Cycle science entirely under the new specification introduced into schools in September 2016.

The overall results from PISA 2022 need to be interpreted with consideration both for the upward bias in the estimates for Ireland outlined in the NRBA, and for the elevated number of countries internationally whose data carry an annotation in this unusual cycle of PISA. However, familiar patterns of achievement and distribution of that achievement have emerged from the 2022 data, showing some consistency of results between cycles, and will be discussed further in the following sections.

7.2 Lower- and Higher-achieving Students

As well as providing an overall view of how students on average are performing in mathematics, reading and science in participating countries and economies, it is also possible to compare the performance of lower- and higher- achieving students across countries and economies in PISA and to examine how the percentages of students at different levels of the performance distribution change over time. PISA describes performance in mathematics in terms of proficiency levels which describe the types of tasks that students can successfully complete at each level. The number of proficiency levels vary for each domain however, across all domains Level 2 is considered the baseline level of proficiency students need to participate fully in society, while students who perform at the highest levels (Levels 5 and 6) are considered top performers.

The pattern of results for Ireland in 2022 is in line with findings from the most recent cycles of PISA, that is that Ireland has much fewer students performing below baseline proficiency compared to the average across OECD countries and to comparator countries, but that percentages reaching the highest levels in PISA in Ireland are much closer to the OECD average or just below it.

For mathematics, 19.0% of students performed below Level 2 in Ireland, compared to an OECD average of 31.1%. Seven, mostly East Asian, countries (Korea, Estonia, Chinese Taipei, Hong Kong, Japan, Macao and Singapore) had lower percentages of students performing below Level 2 than

Ireland. On the other hand, the percentage of students in Ireland reaching the highest levels (7.2%) is slightly lower than the OECD average of 8.7%, and 28 countries/economies had greater proportions of top-performing students than Ireland. While improvements in the percentage of lower-performing students in mathematics were observed in Ireland between 2012 and 2018, with a decrease from 16.9% to 15.7% performing below baseline level, the increase to 19.0% in 2022 means that Ireland now has significantly more lower-achieving students in mathematics than in 2018. On the other hand, there has been small but steady declines in the percentage of the highest performing students in each cycle since 2012. This means that the percentage of top performing students in Ireland in 2022 is significantly lower than in 2012.

A similar pattern is evident for science in 2022, with considerably fewer students performing below baseline proficiency in Ireland (15.6%) compared to the OECD average (24.5%), while the percentage of students performing at the highest levels in PISA in Ireland is the same as at the OECD average (7.5% for both Ireland and the OECD average). Just eight countries (including Canada as well as those who had fewer lower-achieving students for mathematics) had lower percentages of students performing below baseline proficiency than Ireland, while 22 had greater proportions of top-performing students. While there were some small fluctuations in the percentages of lower-achieving students in science in Ireland between 2015 and 2022, these differences are not statistically significant, meaning that the percentages of lower-achieving students in science have been relatively stable since 2015. On the other hand, a drop in the percentage of the highest performing students in Ireland between 2015 and 2018, and then a corresponding increase between 2018 and 2022 means that the percentage of students reaching the highest levels in PISA is significantly higher in 2022 than in 2018 but does not differ from 2015.

Ireland's strong performance in reading in 2022 is characterised by both a lower-than-average percentage of lower-achieving students and a higher-than-average percentage of top performing students. However, while the percentage of the lowest-achieving students in Ireland is less than half the corresponding OECD average (11.4% and 26.3%, respectively), and only Singapore has a very slightly lower proportion of students performing below Level 2, the percentage of the highest-achieving students is closer to the OECD average (10.3% and 7.2%, respectively) and ten countries/economies had greater proportions of top-performing students than Ireland. This includes New Zealand, Canada and United States, all of which had overall mean reading scores than were lower than Ireland's. There has been no statistically significant change in the percentages of lower- and higher-achieving students in reading in Ireland since 2015.

The results from PISA 2022 suggest there is room for improvement at the higher end of the performance distribution in Ireland, particularly in mathematics and science. However, it is important that any efforts to increase the share of top performing students in Ireland should not compromise the relatively strong performance of Ireland's lower-achieving students. Indeed, looking at countries that have similar overall performance to Ireland in mathematics, most of these have higher proportions of both lower- and higher-achieving students than in Ireland. It is also noteworthy that some countries with significantly higher mean performance in mathematics than Ireland, namely Switzerland and Canada, have similar or slightly higher percentages of students performing below baseline proficiency.

The steady decline in the percentage of students in Ireland reaching the highest levels in mathematics since 2012, along with the significant drop in the percentage of lower-achieving students since 2018 suggests that continued efforts are required to ensure that both the lowest- and highest-achieving students are reaching their potential. Estonia provides an example of a country that, despite a significant drop in mathematics performance since 2018, continues to have

significantly higher performance than Ireland and maintains a relatively low proportion of students performing below baseline proficiency (15.0%) and a relatively higher proportion of students reaching the highest levels in PISA mathematics.

The increase in the percentage of students reaching the highest levels in science in 2022 is encouraging. However, while the corresponding small decrease in the percentage of lower-achieving students was not statistically significant, this should be interpreted with consideration of the upward bias that has been noted in the 2022 estimates for Ireland. Although it is not feasible to say for certain where on the proficiency scale the students who did not participate in PISA would be placed, it is possible that more students would have performed below baseline proficiency if the response rate in Ireland had been in line with previous cycles.

A number of targets related to the PISA proficiency levels were included as part of the interim review of the *National Literacy and Numeracy Strategy - Literacy and Numeracy for Learning and Life, 2011-2020* (DES, 2017b) and the *Action Plan for Education 2016-2019* (DES, 2016). The targets set out in the *National Literacy and Numeracy Strategy* were that the percentage of students performing below baseline proficiency would be 8.5% for reading and 10.5% for mathematics while the percentage reaching Level 5 or above would be at least 12% for reading and 13% for mathematics by 2020. Neither of the targets for mathematics were met in PISA 2018 or in PISA 2022. While the target of 12% of students reaching the highest levels in PISA reading was met in PISA 2018, the percentage of students performing at this level in 2022 fell below the target. Similarly, the targets related to the PISA proficiency levels outlined in the *Action Plan for Education 2016-2019*, namely that less than 10% of students would be performing below Level 2 in reading, mathematics and science, and that the percentages reaching Level 5 and above would be 13% for reading and science and above the OECD average for mathematics by 2025, have also not yet been met.

Of course, these targets were set before the onset of the COVID-19 pandemic, and the disruptions to schooling that were experienced between 2020 and 2022 should be noted when interpreting the PISA 2022 findings and the targets outlined in both the *National Literacy and Numeracy Strategy 2011-2020* and the *Action Plan for Education 2016-2019*. With this in mind, the use of PISA targets may need to be revisited in future strategies aimed at improving outcomes in literacy, numeracy and science and consideration should be given to some elements of the design of large-scale international studies such as PISA. Random fluctuations around estimates that can occur due to sampling and measurement error from cycle to cycle mean that small changes in the percentages of students reaching each level are not unusual. As noted by Shiel et al. (2022b), there may be value in specifying targets in terms of percentage bands rather than discrete percentages, to account for the error associated with PISA estimates. Similarly, the effect of response rates and any possible resulting bias that may be present in estimates, particularly for subgroups of the population such as students attending DEIS schools, and the appropriateness of targets for such groups, should also be considered. Gilleece et al. (2020) also noted a number of issues related to the use of targets in PISA for students attending DEIS schools.

It is also important to note that no country in PISA 2022 achieved less than 11% of students performing below Level 2 in reading and only two countries achieved less than 10% of students performing at this level for mathematics, indicating that the targets established for the lowest-achieving students were not met by any country for reading and only a very small number of countries for mathematics. Future target setting may wish to take account of what has been shown to be achievable in other countries, particularly those countries that have managed to maintain high overall performance as well as relatively strong performance amongst both the lowest- and highest-performing students.

7.3 Gender Differences

Both male and female students in Ireland significantly outperformed their OECD peers in each domain; however, some important differences in the performance of males and females are observed across domains and at different levels of the performance distribution. As noted throughout this report, the upward bias present in the 2022 estimates for Ireland and the finding that this bias is likely to be greater for male than female students, should be considered when interpreting changes across cycles.

In reading, the finding that female students significantly outperformed their male counterparts in Ireland is in line with the results from previous cycles of PISA and is also the pattern observed in all but two participating countries (Chile and Costa Rica) in PISA 2022. The gender difference in favour of female students in reading in Ireland has narrowed from 23.2 points in 2018 to 18.3 points in 2022 however, this may partly be due to the greater level of upward bias observed for male students in the 2022 estimates. Despite this, the gender difference in reading appears to be due to a relative underperformance of male students at the lower end of the performance distribution. Just over 14% of male students in Ireland are performing below baseline level in reading which is significantly greater than the corresponding percentage of about 8% for females. On the other hand, a slightly greater percentage of female than male students achieved the highest proficiency levels (11.2% compared to 9.4%). This suggests that attention should continue to be focused on supporting reading literacy among lower-achieving male students.

The pattern of gender differences for science and mathematics in Ireland are different than for reading. Male students obtained a higher mean science score than female students in Ireland, although the difference (5.6 points) was not statistically significant. While no significant gender differences in overall science performance were observed in 2022, it is noteworthy that there was a significant increase of about 11 points in science, on average for male students in Ireland between 2018 and 2022, but no significant change was observed in the average science score of female students in the same period. As with reading, the magnitude of gender differences for science varies across the performance distribution, although, unlike reading, the greatest differences are amongst the highest-achieving students and are in favour of male students. Similar percentages of male (16.1%) and female students (15.0%) are performing below the baseline level of proficiency in science (i.e., Level 2), while significantly more male (9.5%) than female students (5.5%) reached the top levels of proficiency (Levels 5 and 6). These findings point to a relative underperformance in science amongst the highest-achieving females in Ireland.

The pattern for mathematics also points to a relative underperformance among female students in Ireland, with male students significantly outperforming female students by almost 13 points, on average. However, while there is little difference in the percentages of male and female students performing below baseline proficiency in Ireland (18.5% and 19.6%. respectively), a significantly greater percentage of males than female students in Ireland achieved at the highest levels on the PISA mathematics test (9.6% for males and 4.7% for females). Furthermore, while male students saw a non-significant decline of almost five points in their mathematics performance since 2018, the performance of female students dropped significantly by almost 12 points and the percentage of female students performing at the lowest levels in PISA increased from about 16% to almost 20% in the same period. These findings point to the need to support female students across the performance distribution to reach their potential in mathematics.

Findings from previous cycles of PISA have noted gender differences in students' motivation to learn mathematics and their mathematics related self-beliefs, with female students reporting particularly high levels of mathematics anxiety (Perkins et al., 2013). Additional analysis of the PISA 2022 data for Ireland will be carried out in 2024 to further explore the patterns in students' self-beliefs and motivation related to mathematics and how these are related to mathematics performance.

7.4 Students' Experiences of Learning during the Pandemic

The PISA 2022 Main Study took place directly after a time of unprecedented disruption for schools and students and many schools within countries and regions were still dealing with many aftereffects of the pandemic when testing took place. In response to the school disruptions linked to the COVID-19 pandemic a new module, referred to as the Global Crises Module, was introduced into the Student and School questionnaires for PISA 2022. This module gathered information on the effect the pandemic had on teaching, learning, and on students' lives. In particular, the module asked students about the level of supports they received from their school and family during remote learning, the types of challenges they encountered, and their own perceptions of and feelings about learning while their school building was closed.

Relatively high proportions of student in Ireland reported receiving a range of supports from their school every day or almost every day, including being sent assignments (71.6%), having materials uploaded to a school learning platform (70.4%), and being offered live virtual classes on a video communication program (69.5%), while about half of students or fewer across OECD countries reported receiving these supports daily.

Students were also asked to what extent they received help and support from their families during remote learning, and the responses from students in Ireland were broadly similar to the reports of students on average across the OECD. About one in ten students in Ireland and across OECD countries reported that someone in their family helped them with schoolwork, explained new content to them, and helped them find additional learning resources every day or almost every day. Almost a quarter of students in Ireland indicated that a family member asked them what they were learning every day, while about a fifth of students said that a family member checked whether they were completing their school assignments, which is broadly similar to the OECD averages of 22.3% and 19.7%, respectively.

On the other hand, students in Ireland were more likely to report problems with remote learning than their OECD peers however, this appears to be mostly due to students in Ireland indicating that they had problems motivating themselves to do schoolwork; 36.4% of students in Ireland reported experiencing problems motivating themselves to do schoolwork every day or almost every day, compared to 24.8% across the OECD. Students' reports of other problems were less frequent with less than 10% of students reporting that they experienced problems every day or almost every day finding a quiet place to study, finding time to study due to household responsibilities, accessing the Internet, accessing school supplies or accessing digital devices, which is broadly in line with the corresponding OECD averages.

Students' reports about how they felt during remote learning were mixed. Over half of students in Ireland agreed or strongly agreed that they enjoyed learning by themselves (52.5%), and that their teachers were well prepared to provide instruction remotely (55.1%), while over 60% reported that

they improved their skills in using digital devices for learning (62.7%) and that their teachers were available when they needed help (67.7%). These percentages are broadly similar to the corresponding OECD averages. On the other hand, when compared to the OECD average, a greater percentage of students in Ireland reported that they fell behind in their schoolwork (57.2% compared to 47.6%) and that they missed sports and other physical activities organised at school (70.9% compared to 57.0%), while just 25.7% of students in Ireland felt motivated to learn compared to 38.5% across the OECD.

It is clear that despite the relatively high levels of supports received, students in Ireland struggled with many aspects of the sudden shift in their experience of teaching and learning brought on by the COVID-19 pandemic. In particular, many students in Ireland reported difficulty in maintaining their motivation to learn, which may present difficulties for them in their future learning, and these students may require greater supports as they progress through school. Further national reporting which will be published in 2024 will look at students' experience of learning at home during the pandemic in greater detail, as well as examining how students' reported well-being may have changed across PISA cycles.

7.5 Looking Ahead to PISA 2025 and Beyond

The next cycle of PISA will take place in 2025, with a Field Trial taking place in all participating countries in spring 2024. Science will be the main focus of the assessment in the 2025 cycle, and an interactive version of the newly revised science framework, which has an increased emphasis on sustainability, can be found at https://pisa-framework.oecd.org/science-2025/. Adaptive testing will also be integrated for science, meaning that, for the first time, all domains will be assessed using multi-stage adaptive testing. It is also planned to administer the assessment in an online format. As in previous cycles, it is planned to administer the core Student and School Questionnaires in Ireland, along with the optional ICT Familiarity Questionnaire, and the Well-being Questionnaire in 2025.

A new innovative assessment will also be administered alongside the tests of reading, mathematics and science. This innovative domain, *Learning in a Digital World*, will aim to evaluate whether students can use digital tools to learn new things as well as to provide international evidence on the use of digital technologies at school and their relationship with learning outcomes. The assessment, which will be delivered to students online, will focus on self-regulated learning and computational and scientific inquiry practices and will include both a questionnaire and cognitive component.

The frequency of PISA testing will change after the 2025 cycle. Currently, testing in PISA takes place every three years, with the exception of PISA 2022 which was postponed by one-year due to the COVID-19 pandemic. After the ninth cycle of PISA, which will take place in 2025, PISA testing will move to a four-year frequency, meaning that the next Main Study after 2025 will take place in 2029. It is also planned that each domain will receive equal weighting in the 2029 assessment. This will represent a change from the current model where one domain is assessed as the major domain, to which most of the assessment time is devoted, and the other two 'minor' domains receive less assessment time. However, as in previous cycles, the revisions to the cognitive and questionnaire frameworks, as well as the development of new test items, will only focus on one domain per cycle. This means that, in 2029, the reading framework will be updated and new test items will be developed for the reading assessment only. International reporting for the 2029 cycle will also focus on reading as the main outcome.

References

Cosgrove, J., Ní Chobhthaigh, S., Shiel, G., & Leahy, M. (2018). *Digital Learning Framework trial evaluation: baseline report.* Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2018/05/DLF-Trial-Evaluation-Interim-Report-May-2018.pdf.

Cosgrove, J., & Cartwright, F. (2014). Changes in achievement on PISA: The case of Ireland and implications for international assessment practice. *Large-Scale Assessments in Education, 2, 2.* https://rdcu.be/dp5t8.

Cosgrove J. (2011) *Does student engagement explain performance on PISA? Comparisons of response patterns on the PISA tests across time*. Dublin: Educational Research Centre. https://www.erc.ie/documents/engagement_and_performance_over_time.pdf.

Cosgrove, J., Shiel, S., Sofroniou, N., Zastrutzki, S., Shortt, F. (2004). *Education for Life: the achievements of 15-Year-Olds in Ireland in the second cycle of PISA.* Dublin: Educational Research Centre. https://www.erc.ie/documents/p03education_for_life_main_report.pdf.

Darmody, M., Smyth, E., Russell, H. (2020). *The implications of the COVID-19 pandemic for policy in relation to children and young people: a research review* (ESRI Survey and Statistical Report Series Number 94). Dublin: ESRI. https://doi.org/10.26504/sustat94.

Delaney, E., McAteer, S., Delaney, M., McHugh, G. & O'Neill, B. (2023). *PIRLS 2021: Reading results for Ireland*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2023/05/PIRLS-2021_Reading-Results-for-Ireland.pdf.

Denner, S. (2023). *PISA testing, spring vs autumn 2018: a feasibility study*. Dublin: Educational Research Centre.

Department of Education and Skills (DES). (2017a). *Digital Learning Framework for post-primary schools.* Dublin: Author. https://www.dlplanning.ie/wp-content/uploads/2018/10/digital-learning-framework-post-primary.pdf.

DES. (2017b). *Literacy and numeracy for learning and life 2011-2020: new targets 2017-2020*. Dublin: Author. https://assets.gov.ie/24960/93c455d4440246cf8a701b9e0b0a2d65.pdf.

DES. (2016). *Action plan for education 2016-2019.* Dublin: Author. https://assets.gov.ie/24342/ee86271484a64c1b82dce9d4d7af1587.pdf.

DES. (2015). *Framework for Junior Cycle*. Dublin: Author. https://assets.gov.ie/24478/f0edee58373142918ad24abf6db8075f.pdf.

DES. (2011). *Literacy and numeracy for learning and life: the national strategy to improve literacy and numeracy among children and young people*. Dublin: Author. https://assets.gov.ie/24521/9e0e6e3887454197a1da1f9736c01557.pdf.

Department of Education (DoE). (2023a). Minister Foley announces update to Senior Cycle redevelopment. Dublin: Author. https://www.gov.ie/en/press-release/c4bd8-minister-foley-announces-update-to-senior-cycle-redevelopment/.

DoE. (2023b). *What subject inspections tell us about Junior Cycle implementation*
A composite report on findings from subject inspections with a focus on Junior Cycle. Dublin: Author.

DoE. (2022). *Digital strategy for schools to 2027*. Dublin: Author. https://www.gov.ie/pdf/?file=https://assets.gov.ie/221285/6fc98405-d345-41a3-a770-c97e1a4479d3.pdf#page=null.

DoE. (2021). *Remote teaching and learning: summary of Inspectorate research January – February 2021*. Dublin: Author. https://assets.gov.ie/139682/add5b7ca-af76-4db0-a221-c7dee88669c5.pdf.

Donohue, B., Perkins, R., Walsh, T., Delaney, M., Millar, D. (2023). *PISA 2022: Non-Response bias analysis for Ireland*. Dublin: Educational Research Centre.

Educational Testing Service (ETS) (2023). *PISA 2022 Released Field Trial new mathematics items*. New Jersey: Author.

Eivers, E., Shiel, G., Cunningham, R. (2007). *Ready for tomorrow's world? The competencies of Ireland's 15-year-olds in PISA 2006.* Dublin: Educational Research Centre. https://www.erc.ie/documents/p06ready_for_tomorrows_world_main_report.pdf.

ETS. (2021). *PISA 2022 Recommended Main Survey item pool – cognitive assessment*. New Jersey: Author.

European Commission. (2020). *Digital education action plan 2021-2027*. Brussels: Author. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0624.

Feerick, E., Clerkin, A., Cosgrove, J. (2022). Teachers' understanding of the concept of 'embedding' digital technology in education. *Irish Educational Studies,* 41:1, 27-39. https://doi.org/10.1080/03323315.2021.2022521.

Feerick, E., Cosgrove, J., Moran, E. (2021). *Digital Learning Framework (DLF) national evaluation: one year on – wave 1 report*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2021/06/DLF-W1-full-report.pdf.

Gilleece, L., Nelis, S.M., Fitzgerald, C., & Cosgrove, J. (2020). *Reading, mathematics and science achievement in DEIS schools: Evidence from PISA 2018*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2022/03/ERC-DEIS-PISA-2018-Report1_Sept-2020_A4_Website.pdf.

Kiniry, J., Duggan, A., Karakolidis, A., Cunningham, R. & Millar, D. (2023). *The National Assessments of Mathematics and English Reading 2021: Performance Report.* Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2023/05/NAMER2021_Performance-Report_Digital.pdf.

Kirk, P. (2019). Second Level: Junior Cycle reform: five years in, where are we now? In B. Mooney (Ed.), *Ireland's Yearbook of Education 2018-2019* (pp. 26-29). Education Matters.

McGarr, O., Mc Cormack, O., O'Reilly, J., Lynch, R., Power, J., Hennessy, J., O'Meara, N., Neary, A., Leahy, K., Calderon, A., Mac Phail, A., Ó Gallchóir, C., Mc Mahon, J., Lenihan, R., Ní Chathasaigh, C. & Goos, M. (2023) *Exploring the introduction of the Framework for Junior Cycle: A longitudinal study. Interim report No. 2*. University of Limerick research repository. https://doi.org/10.34961/researchrepository-ul.22656892.v1.

McKeown, C., Denner, S., McAteer, S., & Shiel, G. (2019). *Learning for the Future: the performance of 15-Year-olds in Ireland on reading literacy, science and mathematics in PISA 2018*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2020/07/B23321-PISA-2018-National-Report-for-Ireland-Full-Report-Web-4.pdf.

Meinck, S. (Ed.), Fraillon, J. (Ed.), Strietholt, R. (Ed.). (2022). *The impact of the COVID-19 pandemic on education: international evidence from the Responses to Educational Disruption Survey (REDS).* Paris/Netherlands: UNESCO/IEA. https://unesdoc.unesco.org/ark:/48223/pf0000380398.locale=en.

Mohan, G., McCoy, S., Carroll, E., Mihut, G., Lyons, S., Mac Domhnaill, C. (2020). *Learning for all? Second-level education in Ireland during COVID-19* (ESRI Survey and Statistical Report Series Number 92). Dublin: ESRI. https://doi.org/10.26504/sustat92.pdf.

Mullis, I.V.S., von Davier, M., Foy, P., Fishbein, B., Reynolds, K.A., & Wry, E. (2023). *PIRLS 2021 international results in reading*. Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.tr2103.kb5342.

National Council for Curriculum and Assessment (NCCA). (2022). *Senior Cycle review: advisory report.* Dublin: Author. https://ncca.ie/media/5399/scr-advisory-report_en.pdf.

NCCA. (2018a). *Junior Cycle English curriculum specification*. Dublin: Author. https://curriculumonline.ie/getmedia/d14fd46d-5a10-46fc-9002-83df0b4fc2ce/JuniorCycle_-English_-specification_amended_2018.pdf. Paris/Netherlands: UNESCO & IEA.

NCCA. (2018b). *Junior Cycle Mathematics curriculum specification*. Dublin: Author. https://curriculumonline.ie/Junior-Cycle/Junior-Cycle-Subjects/Mathematics/Rationale/.

NCCA. (2018c). *Report of the review of the early enactment of Junior Cycle English.* Dublin: Author.

NCCA. (2015). *Junior Cycle Science curriculum specification*. Dublin: Author. https://curriculumonline.ie/getmedia/f668d804-6283-4d4a-84ab-c71e5b37d198/Specification-for-Junior-Cycle-Science.pdf.

Organisation for Economic Cooperation and Development (OECD). (2023a). *PISA 2022 assessment and analytical framework*. Paris: OECD Publishing. https://doi.org/10.1787/dfe0bf9c-en.

OECD. (2023b). *PISA 2022 Main Study preliminary data adjudication report*, Paris: Author.

OECD. (2023c). *PISA Results 2022. Volume I: The state of learning and equity in education*. Paris: OECD Publishing.

OECD. (2023d). *PISA Results 2022. Volume II: Resilient systems, schools and students.* Paris: OECD Publishing.

OECD. (in press). *PISA 2022 technical report*. Paris: OECD Publishing.

OECD. (2020). *PISA technical standards 2022.* Paris: OECD Publishing. https://www.oecd.org/pisa/pisaproducts/PISA-2022-Technical-Standards.pdf.

OECD. (2019a). *PISA 2018 assessment and analytical framework.* Paris: OECD Publishing. https://doi.org/10.1787/b25efab8-en.

OECD. (2019b). *PISA 2018 Results Volume 1: What students know and can do*. Paris: OECD Publishing. https://doi.org/10.1787/5f07c754-en.

OECD. (2019c), *PISA 2018 Results Volume 2: Where all students can succeed.* Paris: OECD Publishing. https://doi.org/10.1787/b5fd1b8f-en.

OECD. (2018). *Equity in education: breaking down barriers to social mobility*. Paris: OECD Publishing. https://doi.org/10.1787/9789264073234-en.

OECD. (2017). *PISA 2015 assessment and analytic framework: science, reading, mathematics, financial literacy, and collaborative problem solving.* Paris: OECD Publishing. https://doi.org/10.1787/9789264281820-3-en.

OECD. (2016). PISA 2015 Results (Volume I): Excellence and equity in education. Paris: OECD Publishing. https://doi.org/10.1787/9789264266490-12-en.

OECD. (2013). *PISA 2012 assessment and analytical framework: mathematics, reading, science, problem-solving and financial literacy*. Paris: OECD Publishing. https://www.oecd.org/pisa/pisaproducts/PISA%202012%20framework%20e-book_final.pdf.

Perkins, R. & Clerkin, A. (2020). *TIMSS 2019: Ireland's results in mathematics and science*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2021/01/03-ERC-TIMSS-2019-Report_A4_Online.pdf.

Perkins, R., Shiel, G., Merriman, B., Cosgrove, J., & Moran, G. (2013). *Learning for life: the achievements of 15-year-olds in Ireland on mathematics, reading literacy and science in PISA* 2012. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2016/07/Learning-for-life-report.pdf.

Perkins, R., Moran, G., Cosgrove, J., & Shiel, G. (2010). *PISA 2009: The performance and progress of 15-year-olds in Ireland. Summary report.* Dublin: Educational Research Centre. https://www.erc.ie/documents/p09national_summary_report2009.pdf.

Rasinski, T., Padak, N., McKeon, C., Wilfong, L., Friedauer, P. (2005), Is reading fluency a key for successful high school reading?, *Journal of Adolescent & Adult Literacy*, Vol. 49/1, pp. 22-27, https://doi.org/10.1598/JAAL.49.1.3.

Shiel, G. (2022a). *Summative assessment of literacy and numeracy*. Dublin: Department of Education. https://zenodo.org/record/7882174#.ZFOj33bMKUl.

Shiel, G., McHugh, G., Denner, S., Delaney, M., Cosgrove, J., with McKeown, C. (2022b). *Reading literacy in Ireland in PISA 2018: Performance, policy and practice*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2022/05/20-ERC-Reading-Literacy-PISA-2018-Report_A4_Digital-2-FINAL.pdf.

Shiel, G. & Kelleher, C. (2017). *An evaluation of the impact of Project Maths on the performance of students in Junior Cycle mathematics*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2018/07/PM_EvaluationStrand1.pdf.

Shiel, G., Kelleher, C., McKeown, C., & Denner, S. (2016). *Future Ready? The performance of 15-year-olds in Ireland on science, reading and mathematics in PISA 2015*. Dublin: Educational Research Centre. https://www.erc.ie/wp-content/uploads/2019/11/PISA2015-FutureReady-15112019.pdf.

Stancel-Piątak, A., Franck, E., & Kennedy, A. (2022) International findings. In Meinck, S., Fraillon, J., & Strietholt, R. (Eds.), *The impact of the COVID-19 pandemic on education - International evidence from the Responses to Educational Disruption Survey (REDS) (Revised edition)* (pp. 34-53). UNESCO / International Association for the Evaluation of Educational Achievement (IEA).

UNESCO. (2018) *ICT competency framework for teachers Version 3*. Paris: Author. https://unesdoc.unesco.org/ark:/48223/pf0000265721.locale=en.

UNESCO Institute for Statistics. (2018). *Quick Guide to Education Indicators for SDG 4*. Quebec: Author. https://unesdoc.unesco.org/ark:/48223/pf0000265396.

Werlich, E. (1976). *A text grammar of English*. Heidelberg: Quelle and Meyer.

Westat. (2023). *PISA 2022: Weighting summary report for Ireland.* Maryland: Author.

Appendix A

In Ireland, PISA is administered on behalf of the Department of Education by the Educational Research Centre. The DoE and the ERC are supported in their work by a National Advisory Committee.

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