PISA 2022: National Report for Wales

Research report

December 2023

Jenni Ingram, Jamie Stiff, Stuart Cadwallader, Gabriel Lee & Heather Kayton: University of Oxford

Table of contents

List of figures

List of tables

List of tables (Appendix)

Acknowledgements

Executive Summary

Introduction

The Programme for International Student Assessment (PISA) assesses the knowledge and skills in mathematics, reading and science of 15-year-old learners in education systems the world over. PISA is run by the Organisation for Economic Co-operation and Development (OECD), and assessment is typically undertaken every 3 years, allowing us to chart how performance changes over time and across different education systems. PISA 2022, which was undertaken 4 years after the previous cycle due to the global COVID-19 pandemic, involved 81 education systems, including Wales.

In Wales, 2,568 15-year-old learners from 89 schools completed a 2-hour computer-based assessment and learner questionnaire. Headteachers at participating schools were also asked to complete a questionnaire. The study was carried out in November and December 2022, with most of those learners who participated completing their GCSE exams in 2023. Data collection for PISA had originally been planned for 2021 but was delayed by a year because of the COVID-19 pandemic. This report analyses their performance in the three subject domains of mathematics, reading and science. Their responses to the questionnaire are also analysed, as are the responses of their headteachers.

When reading this report, it is important to keep in mind that the sample of participating learners may not be entirely representative of all learners in Wales. This is, to some degree, always the case with international studies such as PISA, but in this case the sample for Wales did not meet some of the PISA standards (an expectation that 85% of sampled schools and 80% of sampled learners will participate, once sample weights are applied to account for any sub-populations that may be under- or over-represented). Of the 127 schools sampled, 75 participated, with a further 14 additional schools recruited to bolster the participation rate. This resulted in a final weighted response rate of 71% for schools and 75% for learners. It is likely that COVID-19 had an effect on recruitment and retention, with some schools deciding that they were unable to take part in the study and others needing to withdraw.

To investigate the impact of this, analysis of the characteristics of the schools and learners who participated was undertaken. For Wales, the analysis showed that the sample represented schools and learners well in general, but that the characteristics of the participating schools may have led to an over-representation of learners with higher average academic attainment when compared to the general population. This analysis used estimates of the number of 15 year-old learners enrolled in those participating schools. In the case of Wales, using these estimates, the potential bias in the PISA results was effectively reduced statistically as part of the analysis process, through the use of adjusted weightings. However, in some of the education systems where the PISA standards were not met, such adjustments may be less effective and some results may

therefore be somewhat higher than they might otherwise be. Given that the samples elsewhere in the UK, in several OECD countries, and in other comparator countries, may not be entirely representative of those countries' populations, some caution is required when interpreting the analysis that is presented in this report, particularly when comparing Wales' results with those of other countries, and with the OECD average scores that are reported throughout this report.

For clarity, the term 'significant' is used throughout this report to refer to statistically significant differences between scores or values. In this report, we use a '95% confidence level' to define statistical significance. A statistically significant result is one that is not likely to occur by chance due to the sampling process, and is more likely to be attributable to a genuine difference between the groups that are being compared. Similarly, the term average, as in 'average score', is used to refer to the statistical mean for the relevant group, unless stated otherwise.

Highlights

- Wales' average score for mathematics in 2022 was significantly lower than the average across OECD countries.

- Wales' average scores for mathematics, reading and science have all declined significantly since 2018. This was also the case on average across OECD countries for mathematics and reading, although for science the difference between the OECD average in 2022 was not significantly different to that in 2018.

- The gap in performance between pupils from the most disadvantaged backgrounds and the least disadvantaged backgrounds was smaller in Wales than it was on average across OECD countries for all subjects.

- As with previous PISA cycles, the highest performing education systems tend to be in East Asia, with Singapore, Taiwan, Macao, Japan and South Korea appearing among the top performing systems for all three subject domains.

Achievement in mathematics

Learners in Wales achieved a mean PISA mathematics score of 466 in 2022. To place this in context, this score was significantly lower than the OECD average score of 472. Learners in 42 of the education systems who participated in PISA 2022 mathematics assessment achieved an average score that was significantly below that of Wales, with a further 11 education systems having scores that were not significantly different. The highest performing education systems were Singapore, Macao, Taiwan, Hong Kong, Japan, and South Korea. Learners in 26 of the other participating education systems achieved an average mathematics score that was significantly above that of Wales.

For PISA 2022, performance in mathematics was, on average, significantly lower across the OECD in comparison to average performance for PISA 2018 (when considering only those OECD countries who participated in both 2018 and 2022). It seems probable that the COVID-19 pandemic had an impact on the performance of learners around the world. Wales' score of 466 was significantly lower than the 487 achieved in 2018. In total, 26 of the higher performing participating education systems (with scores over 450) saw a significant decrease in their average mathematics score in 2022 relative to 2018, and only one education system saw a significant increase.

PISA describes performance in terms of levels of proficiency, which are determined by the band within which a score falls. Higher proficiency levels represent better knowledge and skills in relation to the subject domain. The percentage of learners in Wales who performed at the highest mathematics proficiency levels, Levels 5 or 6, was 6%, which was significantly smaller than the OECD average of 9%. The percentage of learners in Wales working at the lowest mathematics proficiency levels (those below Level 2) was 32%, which was not significantly different to the OECD average of 31%.

Achievement in reading

For PISA 2022, Wales' average score in reading was 466. This was significantly below the OECD average of 476. Learners in 45 of the education systems who participated in the PISA 2022 reading assessment achieved an average score that was significantly below that of Wales, with a further 6 education systems having reading scores that were not significantly different from Wales'. Learners from 27 of the other participating education systems achieved an average score that was significantly above that of Wales. The highest performing education systems were Singapore, the Republic of Ireland, Japan, South Korea, Taiwan and Estonia.

Wales' average score in reading for PISA 2022 was significantly below the average score in 2018 (483). However, this was a pattern that was observed in many education systems, and the OECD trend[1] average was also significantly lower in 2022 (477) than in 2018 (488). In terms of PISA's reading proficiency levels, the percentage of learners in Wales who performed at the highest proficiency levels, levels 5 or 6, was 5%, which was significantly different to the OECD average of 7%. The percentage of learners in Wales working at the lowest proficiency levels (those below Level 2) was 29%, which was not significantly different to the OECD average of 26%.

---

[1] Note that, when comparing different PISA cycles (trend data), the report uses the average across OECD countries in 2022 excluding Costa Rica, Luxembourg and Spain.

Achievement in science

Wales' overall average score in science in PISA 2022 was 473. This was significantly lower than the OECD average of 485. There were 6 education systems which participated in the PISA 2022 science assessment which scored similarly to Wales, 30 which scored significantly higher, and 43 which scored significantly less. The highest performing education systems for science were Singapore, Japan, Macao, Taiwan, South Korea, and Estonia.

The OECD trend average was not significantly lower in 2022 than in 2018. Wales' overall average science score for 2022 (473) was, however, significantly different to the score of 488 that was obtained in PISA 2018. In contrast, 13 of the higher-performing education systems (those with scores above 400) did improve significantly in comparison to 2018, while the scores for 14 education systems, including Wales, were significantly lower in 2022 when compared to 2018.

In terms of PISA's science proficiency levels, the percentage of learners in Wales who performed at the highest levels, Levels 5 or 6, was 6%, which was significantly different to the OECD average of 7%. The percentage of learners in Wales working at the lowest proficiency levels (those below Level 2) was 27%, significantly higher than the OECD average of 24%.

Performance by learner characteristics

Learners' PISA scores in mathematics, reading and science were analysed by gender and socioeconomic status, alongside other learner characteristics.

Across the OECD countries, the average mathematics score for boys (477) was significantly higher than that for girls (468). This was also true in Wales, where the average score for boys (470) was significantly higher than that for girls (461). For reading, girls in Wales performed significantly better than boys, with an average score of 475 for girls compared to an average score of 456 for boys. Across the OECD, the average score for girls (488) was also scored significantly higher than that for boys (464). For science, girls in Wales had an average science score of 469, compared to an average of 477 for boys, but this does not represent a statistically significant difference in performance. On average across the OECD, there was also no significant difference in the performances of girls (485) and boys (485) in science.

In terms of socioeconomic status, there was a 76 score point difference in mathematics performance between the most disadvantaged group and the least disadvantaged group in Wales. This was significantly smaller than from the OECD difference of 93 score points. For reading, the difference in performance between the most disadvantaged group and the least disadvantaged group was 65 score points, which was also significantly smaller than the average gap across the OECD (93 score points). Finally, for

science, the performance gap between the most disadvantaged group and the least disadvantaged group was 81 score points, which was again significantly smaller than the performance gap on average across OECD countries (96 score points).

Learner wellbeing, aspirations and experiences of teaching and learning

Learners who participated in PISA 2022 were asked to complete a questionnaire relating to their attitudes and beliefs, experiences in school, hopes for the future and general wellbeing. Learners are asked to rate their overall life satisfaction on a scale from 0 to 10, with 0 indicating very low life satisfaction, and 10 indicating very high satisfaction. Learners in Wales reported a significantly lower average level of satisfaction (6.16) when compared to the average across the OECD education systems (6.75). The extent to which a learner feels satisfied with their life is related to performance in the PISA mathematics assessment. Those learners who reported a rating of 7 or 8 had the highest average score in mathematics, with an average score of 486.

The majority of learners in Wales (63%) reported that they felt like they belonged at school. On average across OECD countries, 75% of learners reported that they felt like they belonged in school. Learners who reported a stronger sense of belonging at school had significantly higher mathematics scores on average than learners who did not feel this way. Around 60% learners in Wales believe that some people are not good at mathematics, English/Welsh, or being creative, no matter how hard they try, which suggests that they these learners may not hold 'growth mindsets'. Dweck (2006; 2016) argues that such learners may be less willing to embrace educational challenges and acknowledge and learn from criticism.

Learners in Wales rated the quality of their mathematics instruction on a scale of 1 to 10 (with 10 indicating the best mathematics instruction possible). In Wales, the average rating was 6.8, which was similar to the OECD average of 6.4. Learners in Wales were generally positive about their mathematics teachers, with the majority reporting that their teacher helps with their learning in every or most lessons (79%). This was similar to the proportion reported by learners on average across OECD education systems (72%).

Schools

When asked about school admission policies, headteachers reported that the residential area of the learner was a key factor in the school's decision (76% of learners in Wales were in schools where this was the case). Headteachers indicated that another important factor was whether the learner had a family member who was currently or formerly at the school (46% of learners in Wales were in schools where this was a factor in admissions decisions).

The majority of learners in Wales were in schools where teacher monitoring and evaluation approaches were in use. These approaches include tests or assessments of learner achievement, teacher peer review, and lesson observations. Similarly, the majority of learners in Wales were in schools where a range of teacher training development activities and workshops were used, as reported by headteachers.

PISA across the United Kingdom

When comparing the UK nations, it is important to remember that school-level and learner-level response rates did not meet some of the PISA sampling standards in each UK nation and caution is required when interpreting the analysis. In the case of Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

All four UK nations have lower average scores for mathematics and reading relative to their performance in 2018. This, as we have seen, is common across the education systems that have participated in PISA 2022.

The UK nations were compared in terms of their performance in mathematics, reading and science. The average mathematics score for Wales (466) was significantly lower than the average scores for England (492) and Northern Ireland (475) and was not significantly different to the average score for Scotland (471). For reading, the average score for Wales (466) was significantly lower than those for England (496), Scotland (493) and Northern Ireland (485). This was also the pattern for science, where the average science score for Wales (473) was significantly lower than the average scores for England (503), Northern Ireland (488) and Scotland (483).

Gender differences in PISA 2022 were consistent across the nations of the UK, with boys having a significantly higher average score for mathematics and girls having a significantly higher average score for reading. In science there were no significant gender differences in any nation of the UK. Learners from relatively less disadvantaged socioeconomic backgrounds performed significantly better than those from relatively more disadvantaged backgrounds across all domains and all UK nations.

1 Introduction to PISA

1.1 What is PISA?

The Programme for International Student Assessment (PISA) is a study of 15-year-old[2] learners around the world organised by the Organisation for Economic Co-operation and Development (OECD). PISA assesses the knowledge and skills that are considered necessary for participation in social and economic life, specifically in mathematics, reading and science. Although PISA is typically carried out every 3 years, PISA 2022 was undertaken 4 years after the previous assessment in 2018 because of the global COVID-19 pandemic.

Although mathematics, reading and science are always assessed, each round of PISA focuses on one of these three areas in particular – this is called the 'major domain'. The major domain for PISA 2022 was mathematics, as it was in 2012 and 2003, with reading and science as minor subject domains. In Wales, England and Northern Ireland, PISA 2022 was carried out on behalf of the respective governments by Pearson and Oxford University Centre for Educational Assessment (OUCEA), which acted as the National Centre for PISA 2022. The data for Wales is collected as part of a wider collaborative effort with the other nations of the United Kingdom, and although this report focuses on Wales the OECD reports on the UK as a whole.

Across different assessment cycles, the OECD presents PISA scores on the same scale to enable countries to identify and monitor trends in learner performance over time. Each participating country receives a detailed breakdown of their results, allowing them to understand how groups of learners with differing demographic characteristics have performed (e.g., learners from different socioeconomic backgrounds). The data collected through PISA also enables governments to benchmark education policy and performance, to make evidence-based decisions and to learn from policies and practices in other countries.

In this chapter, we provide an overview of the PISA study. First, we provide information about other countries that participate in PISA and a description of Wales' past participation. We then provide a guide to interpreting the PISA results, including details of the study design, data collection and analysis. Finally, we provide an overview of the structure of the report.

1.2 Who participates in PISA?

The number of participating PISA education systems has increased from 43 in the initial cycle to 81 in the current PISA 2022 cycle (OECD, 2023a), and around 690,000 learners

---

[2] Refer to Appendix A for a more detailed description of the PISA age range.

participated worldwide. Of the 81 participating countries, 37 were members of the OECD, including the United Kingdom.

1.2.1 Which other countries participate in PISA?

The participating OECD countries are: Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Italy, Japan, Latvia, Lithuania, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, the Republic of Ireland, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

The participating partner countries and economies (education systems) are: Albania, Argentina, Azerbaijan (Baku City only), Brazil, Brunei, Bulgaria, Cambodia, Croatia, Cyprus, Dominican Republic, El Salvador, Georgia, Guatemala, Hong Kong, Indonesia, Jamaica, Jordan, Kazakhstan, Kosovo, Macao, Malaysia, Malta, Moldova, Mongolia, Montenegro, Morocco, North Macedonia, Palestinian Authority, Panama, Paraguay, Peru, Philippines, Qatar, Romania, Saudi Arabia, Serbia, Singapore, Taiwan, Thailand, Ukrainian regions[3], United Arab Emirates, Uruguay, Uzbekistan and Vietnam.

In this report Cyprus was not included when comparisons were made between the performance of pupils in Wales and pupils in other participating education systems as the data were not available at the time of writing. Vietnam was also excluded from the analysis of reading performance as the OECD were unable to make a strong link between their data and the PISA reading scale.

1.2.2 Wales' participation in PISA

In Wales, 2,568 15-year-old learners from 89 schools completed a 2-hour computer-based assessment and learner questionnaire. In all countries, headteachers at participating schools were also asked to complete a questionnaire, which included questions regarding school resources and other contextual information. The study was carried out in November and December 2022, and most learners who took part were due to complete their GCSE exams in 2023. Wales has participated in all studies since the first PISA study in 2000.

1.3 What does PISA measure?

Each cycle of PISA assesses learners in mathematics, reading and science. The reading and science frameworks have remained unchanged from the PISA 2018 cycle. The major domain for PISA 2022 was mathematics and a new mathematics assessment framework was developed for this cycle.

---

[3] 18 of the 27 regions in the Ukraine participated in PISA 2022 (please see OECD, 2023e, for further information).

1.3.1 The PISA 2022 assessment frameworks

In each PISA cycle, a new assessment framework for the major domain is developed (mathematics in PISA 2022). This outlines the specific skills to assess mathematical literacy and the way in which they will be measured. The PISA 2022 mathematics framework is available on the OECD website, along with sample mathematics items.

The OECD's definition of mathematical literacy has a particular focus on learners who are becoming proficient users of mathematics across school and everyday life. The definition of mathematical literacy used in PISA 2022 is:

> 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 helps individuals know the role that mathematics plays in the world and make the well-founded judgments and decisions needed by constructive, engaged and reflective 21st Century citizens. – *OECD (2023b, p.7)*

The PISA 2022 mathematics assessment framework includes a new component of mathematical reasoning in addition to the three components of Formulate, Employ, and Interpret and Evaluate used in the PISA cycles since 2000. PISA 2022 also looks at four content knowledge areas: Quantity, Uncertainty and Data, Change and Relationships, and Space and Shape.

Reading literacy is defined as a learner's capacity to "understand, use, evaluate, reflect on and engage with texts in order to achieve one's goals, develop one's knowledge and potential, and participate in society" (OECD, 2023b, p.14).

Science literacy is defined as "the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person 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, 2023b, p.14).

1.3.2 The PISA questionnaires

Alongside the PISA assessments in mathematics, reading and science, participating schools and learners are asked to complete questionnaires. The learner questionnaire requests information about participating learners' background, their attitudes and feelings, their educational experiences and their future aspirations. As mathematics was the major domain for PISA 2022, learners were also asked to report on their experiences and attitudes to mathematics in greater detail. The school questionnaire requested

information about the school climate, resources, and perceived barriers to learning, as well as perceptions of the impact of the COVID-19 pandemic.

1.3.3   The PISA assessment

Following a detailed, iterative review of the test items (questions) by different local and international experts, the PISA 2022 items were translated into different languages and, where appropriate, verified by the PISA consortium (OECD, 2023c). Through a field trial process, items were evaluated using samples of 15-year-old learners across all participating countries. This ensured that the items met PISA's technical specifications and were comparable across education systems.

PISA takes a sophisticated and therefore technically complex approach to the design and administration of assessment. This differs from more conventional assessments, such as GCSE examinations, where every learner takes the same test with the same items, and the cohort's average performance is an aggregation of these individual learner performances. As mentioned above, the assessment itself is computer-based and, unlike other international assessments, employs multi-stage adaptive testing (for mathematics and reading). An adaptive test is one which automatically selects items to suit the ability of the person taking it. This meant that learners were presented with 'blocks' of items that were selected based on their performance on preceding question blocks.

For more detailed and technical information, please refer to the PISA 2022 Technical report (OECD, forthcoming)[4].

1.3.4   PISA study design and sampling

It is impractical for the PISA assessment to be administered to every single learner in each participating country. Participating countries therefore assess a sample of their eligible learners. The OECD employs a two-stage sampling method to ensure that the learners chosen to take part in the study are nationally representative of the learner population as a whole. The first stage is to sample schools, the second to sample learners within the selected schools. Countries that participate in PISA are required to adhere to strict international sampling procedures which facilitates sample comparability.

In line with this procedure, a sample of secondary schools were selected to take part in PISA 2022. Schools were selected to represent the different geographical regions within Wales, the different types of school that learners may attend (for example, maintained or independent), and a range of academic attainment at the school level (based on the GCSE performance of previous learner cohorts). Within each participating school, a random sample of 40 eligible learners were selected to take the assessment. Most of these learners were in year 11.

---

[4] This report will be available on the OECD website: https://www.oecd.org/pisa/publications/

With any sample, some sub-populations may be under or over-represented once the final data is obtained. It is important to note that the PISA design counteracts this, as far as is possible, through statistical methods (sample weighting). Please refer to the PISA 2022 Technical Standards (OECD, 2023d) for further detail. The response rates for Wales in relation to these Technical Standards are discussed below, in the section titled Interpreting data from PISA 2022: a reader's guide.

1.4 Interpreting data from PISA: a reader's guide

This section provides important information and context for interpreting Wales' results in PISA 2022. As discussed, the PISA 2022 data for Wales are based upon a sample of learners rather than a census of all learners. This means that there is a degree of uncertainty in the findings because, however carefully selected the sample, there is always at least some chance that it does not fully represent the overall population of learners. This uncertainty is described as 'sampling error', though it does not mean a mistake has been made - it is present in all research which relies on the analysis of data taken from a sample.

Another source of uncertainty is 'measurement error', which relates to the extent to which an individual learner's performance on the PISA test reflects their true ability. Measurement error occurs because a learner's score may be influenced by factors that are unrelated to their ability, such as their interpretation of the items that they respond to or their level of motivation on the day of the test.

To contextualise and account for this uncertainty, statistical analysis of the differences between countries and groups of learners is undertaken in this report to determine whether they are 'statistically significant'. Statistically significant differences are unlikely to be the result of either sampling or measurement error and are likely to reflect a true difference between the education systems or groups being compared. In this report, we use a '95% confidence level' to define statistical significance, which means that there is less than a 1 in 20 chance that the finding is due to sampling or measurement error. For clarity of writing, the term 'significant' is used throughout this report to refer to statistically significant differences between scores or values. Similarly, the term average, as in 'average score', is used to refer to the statistical mean for the relevant group, unless stated otherwise.

Particular caution should be taken when considering the 'rank order' of countries who participated in PISA. The two forms of uncertainty discussed above mean that, were the test to be retaken, there would likely be differences in the average scores of each country that would cause the rank order of performances to change. This report therefore focuses on statistically significant differences between countries and groups, providing greater confidence that findings are robust. As discussed above, findings should also be considered with regard to how representative the learners who took the test (the sample)

are of the population of learners as a whole. Section 1.4.2 discusses this with regard to Wales in 2022.

It is also important to note here that test items may not be equally difficult for learners from different socio-cultural or language backgrounds, or across countries and translations. Previous research suggests that some test items may not have necessarily performed in a comparable manner across different countries and languages, thus somewhat undermining the comparability of results (Kreiner & Christensen, 2014; Rutkowski et al., 2016). During the aforementioned PISA development cycle, the OECD make every effort to ensure that comparisons between countries and translations can be validly made but the cross-country comparisons presented in this report should still be cautiously interpreted, especially when comparing distinct educational systems and different languages.

1.4.1   PISA and the COVID-19 pandemic

Data collection for PISA (the administration of the assessment and the questionnaires) had originally been planned for 2021 but was delayed by 12 months because of the COVID-19 pandemic. Although data collection was undertaken in November and December of 2022, the ongoing situation had an impact on recruitment, retention and learner engagement.

The pandemic caused widespread disruption to schools, teaching and learning, which included significant periods of time when school buildings were closed. Remote instruction or distance learning resources were made available in line with Government guidance at the time. Schools were also offering a range of programmes and types of support to learners whose learning and wellbeing were affected. However, the impact of this disruption varied between regions, schools and individual learners within those schools, as well as between different countries and education systems.

Given this complexity, it is not possible to ascertain precisely how the COVID-19 pandemic affected performance in the PISA 2022 assessments for those who were able to participate, or how it may have affected their responses to the questionnaires. A small number of items were included in the learner and school questionnaires that specifically focused on the impact of the COVID-19 pandemic, but as fewer than 70% of participating learners or headteachers responded to the majority of these items they have not been included in this report (although they are reported on in the OECD's international report).

In terms of delivering the assessment process, schools were still experiencing issues around the availability of staff in 2022 and were seeking to prioritise support for the learning and wellbeing of their learners. This, understandably, had an effect on recruitment, with some schools deciding that they were unable to take part in the study and others having to withdraw late in the process, sometimes during the data collection period itself. In such cases, it was not always possible to recruit replacement schools

(similar schools to replace them in the sample) in the time available. We further discuss response rates, and what they mean for interpreting the findings of PISA 2022, below.

The disruption caused by the COVID-19 pandemic also caused some changes in how parts of the data collection process were undertaken. For example, the field trial that is undertaken ahead of each series of PISA, the purpose of which is to establish the suitability of new test items, was disrupted, though it still produced sufficiently detailed data ahead of the main assessment window. In addition, it was necessary to undertake certain processes, such as the training of coders (markers) and the coding itself, remotely. These processes worked efficiently but were different to those operated in previous cycles of PISA. Despite these challenges, it is important to note that, of the 82 PISA technical standards, 80 were successfully met for Wales. The two standards which were not met relate to response rates and are discussed below.

1.4.2   PISA 2022 response rates for Wales

PISA Technical Standard 1.11 states that the final weighted school response rate should be at least 85% of sampled eligible and non-excluded schools. Where a response rate is below 85%, an acceptable response rate can still be achieved through the recruitment of replacement schools. For Wales, the initial weighted response rate was 60%. Replacement schools were recruited, however, the final weighted school response rate (71%) was still below the threshold for PISA's Technical Standard. Similarly, PISA Technical Standard 1.12 states that the final weighted learner response rate should be at least 80% of all sampled learners across responding schools. For Wales, the final weighted learner response rate was 75%, again below the OECD target.

Given that these response rates did not meet the relevant Technical Standards, a Non-Response Bias Analysis (NRBA) was undertaken to understand, among other things, differences between responding and non-responding schools and between originally sampled schools and replacement schools. The purpose of this analysis was to establish the extent to which the final sample of learners is likely to represent the population of learners in Wales. The key findings of the NRBA, and what they mean for interpreting Wales' PISA 2022 results are described briefly below, and a full report of the analysis can be found in Appendix A.

It is important to be clear that the task of ensuring a high participation rate was particularly challenging in the context of the COVID-19 pandemic that Wales was not the only nation unable to meet the PISA sampling technical standards. Australia, Canada, England, the Republic of Ireland, the Netherlands, Northern Ireland, New Zealand, Scotland and the United States were among those final weighted samples did not meet the threshold, mentioned here because this report will be comparing their performance to that of Wales in subsequent chapters. PISA sampling technical standards were also unmet in a number of other OECD countries that are included in the 'OECD average' scores which also serve as a comparison throughout the report.

For Wales, the non-response analysis showed that the sample in Wales represented schools and learners well in general, though with a slight potential bias in the percentage of schools participating from the different school attainment bands which was largely reduced through the non-response adjusted weighting applied in the analysis. The issues with non-response, both for Wales and for other participating education systems, mean that cautious interpretation is particularly necessary when considering trends in performance over time and when making international comparisons. More confident conclusions can be drawn when making comparisons between groups of learners within Wales, where we are not trying to generalise beyond our sample (such analysis takes place in Chapter 5, where a fuller explanation is provided). Overall, while cautious consideration of the results is encouraged, the analysis remains a valuable insight into the knowledge and skills of 15-year-old learners in Wales in mathematics, science and reading, and how they compare to other 15-year-old leaners from around the world.

1.4.3   Selection of comparator education systems

Given the large number of education systems that participated in PISA 2022, it is necessary to be selective when making international comparisons. For this report, three main education systems have been selected for comparison to Wales. These education systems are the Republic of Ireland, New Zealand, and Norway, and they have been selected on the basis that they provide valid, meaningful and valuable comparisons, serving to contextualise the performance of learners from Wales. All share similarities to Wales but all exhibited better performance in the last cycle. The Republic of Ireland is culturally similar to Wales and is bilingual. Norway is of interest because of their use of differing assessment practices, while New Zealand shares meaningful similarities to Wales in terms their approach to curriculum development. Additional comparisons are made for each domain: Croatia for mathematics, Italy for science, and the Netherlands for reading. These additional comparisons are on the basis that the relevant education system has performed similarly to Wales in that domain historically.

The report also frequently compares information about Wales' performance to the OECD average performance. The OECD average has been selected for such comparisons, rather than the average for all education systems who participated in PISA 2022, because they are more economically comparable to Wales and have participated in PISA more consistently over time. For 2022, the OECD average included 37 education systems – all 38 OECD countries apart from Luxembourg, which did not participate in PISA 2022. However, the countries which are part of the OECD have changed over time as the OECD has expanded; for example, Costa Rica has joined the OECD since PISA 2018. This means that the OECD average for each cycle of PISA includes a different number of countries. In order to ensure comparisons are consistent and any changes over time in the OECD average are not unduly distorted by the countries which are included or excluded in a given comparison, the OECD has calculated several different averages. These include different sets of education systems, allowing for accurate comparisons of change over time to be made in different contexts.

This report will be comparing Wales' performance to two different OECD averages, depending on the most appropriate comparison. When comparisons are made to 2022, the report uses the average of all 37 OECD countries which participated in PISA 2022. When comparing trend data, the report uses the average across the 35 OECD member countries which took part in both 2018 and 2022, and have results included in the international reports for both cycles. This allows more consistent comparisons to be made. These differing averages will be called the 'OECD Average' and the 'OECD trend Average' respectively.

1.5   Organisation of this report

The rest of this report is divided into 8 main chapters. Chapters 2 to 6 focus on Wales' performance in PISA mathematics, reading and science. Each chapter generally includes information on the distribution of learners' test scores by learner and school characteristics, and an overview of how Wales' performance has changed over time in relation to other participating education systems. As mathematics was the focus of PISA 2022, a detailed comparison of performance across content and cognitive domains will be presented for mathematics in Chapter 3.

Chapter 7 provides details of learners' responses on the PISA background questionnaire, with an emphasis upon how they view mathematics. It also investigates learners' wellbeing and their aspirations, taking into consideration how these have changed over time, and how they compare to other parts of the world. The chapter also provides details on how learner wellbeing and aspirations relate to performance in mathematics, reading and science.

Chapter 8 is about the school environment. The chapter focuses on the views of headteachers as reported in the PISA school questionnaire. This includes measures of school management, policies, resources, staff inclusiveness and access to digital devices. This chapter ends by exploring school-level variation in mathematics performance across Wales.

Chapter 9 focuses on the similarities and differences in outcomes between the 4 nations of the United Kingdom. This includes how test scores vary across the UK, and whether gender and socioeconomic gaps are bigger in some nations of the UK than others.

2 Performance in mathematics

2.1 Chapter overview

This chapter reports the performance of learners in Wales in mathematics. It draws on findings outlined in the international report (OECD, 2023e) and places outcomes for Wales in the context of those findings. This performance is considered alongside that of previous cycles, PISA 2018, 2015 and 2012. Caution needs to be taken in interpreting these findings as some of the sampling standards for PISA 2022 were not met in Wales as described in Chapter 1.

2.2 Key findings

- Wales achieved an average score of 466 in mathematics in 2022 which was significantly lower than the OECD average of 472.

- Average performance in mathematics was lower on average across the OECD in PISA 2022 (475) compared to PISA 2018 (490) when considering the average across OECD trend countries, and Wales' score of 466 was similarly lower than the 487 achieved in 2018.

- In total 41 of the 72 education systems that participated in both 2018 and 2022 saw a significant decrease in their average mathematics score in 2022 with only 7 education systems seeing a significant increase. The remaining 24 education systems saw no significant change in their scores.

- Learners in 42 out of the other 79 participating education systems[5] achieved an average score that was significantly below Wales, with a further 11 education systems having mathematics scores that were not significantly different from that in Wales, and 26 education systems achieving an average score that was significantly above the average score in Wales.

- The gap between Wales' highest- and lowest-performing learners in mathematics was 233 score points, which was not significantly different from the OECD average of 235 score points.

- In total 6% of learners in Wales were top performing, attaining at Level 5 or 6, which was significantly smaller than the OECD average of 9%.

- The proportion of learners in Wales working at the lowest proficiency levels was 32%, which was not statistically significantly different from the OECD average of 31%.

---

[5] International comparisons involving Wales in this report do not include Cyprus as these data were not available at the time of writing.

2.3   Introduction to PISA mathematics

This chapter focuses on Wales' performance in the mathematics domain of PISA. It outlines how Wales performance in 2022 compares to that of other participating education systems, as well as how performance has changed over time. In PISA 2022, mathematics was the major domain and was assessed using the OECD 2022 mathematics framework (OECD, 2023c). It was previously the major domain in 2012 and was one of the minor domains in 2018 and 2015.

The data for Wales is collected as part of a wider collaborative effort with the other nations of the United Kingdom, and although this report focuses on Wales the OECD reports on the UK as a whole.

As Wales' school-level and learner-level response rates did not meet some of the PISA sampling standards, caution is required when interpreting the analysis reported here. Cautious interpretation is particularly necessary when considering trends in performance over time and when making international comparisons. The Republic of Ireland and New Zealand, which have been included as comparator countries, also did not meet some of the PISA sampling standards as well as some of the other OECD countries included in the OECD averages. For more information see Section 1.4.2.

2.4   Wales' performance in mathematics

Learners in Wales achieved an average score of 466 in mathematics in PISA 2022. This was significantly below the OECD average score of 472.

In 2022, of a total of 81 education systems, 23 had an average score significantly above the OECD average 10 education systems were not significantly different to the average and 48 education systems were significantly below the OECD average. As in previous cycles, most of the top-performing education systems were from East Asia (Singapore (575), Macao (552), Taiwan (547), Hong Kong (540), Japan (536) and South Korea (527)). The European countries that had an average score significantly above the OECD average were Estonia (510), Switzerland (508), Netherlands (493), the Republic of Ireland (492), Belgium (489), Denmark (489), United Kingdom (489), Poland (489), Austria (487), Czech Republic (487) Slovenia (485), Finland (484) and Sweden (482). New Zealand (479), Norway (468), and the United States (465) had average scores in mathematics that were not statistically significantly different from the OECD average. The remaining comparator country, Croatia (463), had an average mathematics score significantly lower than the OECD average.

Learners in 42 out of the other 79 participating education systems[6] achieved an average score that was significantly below Wales, with a further 11 education systems having

---

[6] International comparisons involving Wales in this report do not include Cyprus as these data were not available at the time of writing.

mathematics scores that were not significantly different from that in Wales, and 26 education systems achieving an average score that was significantly above the average score in Wales. Among OECD countries, learners on average in Hungary (473), Portugal (472), Italy (471), Norway (468), United States (465), Slovakia (464), Iceland (459) and Israel (458) performed similarly to learners in Wales. A further 6 OECD countries had average mathematics scores that were significantly below the average score in Wales, and 22 OECD countries had average mathematics scores that were significantly above the average score in Wales. The results of the 54 higher-performing education systems with an average score of 400 points or higher are presented in Table 2.1. The 26 education systems with an average score less than 400 are not included in Table 2.1.

Table 2.1: Mathematics performance of higher-performing education systems in PISA 2022 relative to Wales

Performance relative to Wales	Education system and score
Education systems that scored significantly higher than Wales in mathematics in PISA 2022	Singapore (575), Macao (552), Taiwan (547), Hong Kong (540), Japan (536), South Korea (527), Estonia (510), Switzerland (508), Canada (497), Netherlands (493), Republic of Ireland (492), Belgium (489), Denmark (489), Poland (489), Austria (487), Australia (487), Czech Republic (487), Slovenia (485), Finland (484), Latvia (483), Sweden (482), New Zealand (479), Lithuania (475), Germany (475), France (474), Spain (473)
Wales and education systems that did not score significantly higher or lower than Wales in mathematics in PISA 2022	Hungary (473), **OECD average (472),** Portugal (472), Italy (471), Vietnam (469), Norway (468), Malta (466), **Wales (466),** United States (465), Slovakia (464), Croatia (463), Iceland (459), Israel (458)
Education systems that scored significantly lower than Wales in mathematics in PISA 2022	Turkey (453), Brunei (442), Ukrainian regions (441), Serbia (440), United Arab Emirates (431), Greece (430), Romania (428), Kazakhstan (425), Mongolia (425), Bulgaria (417), Moldova (414), Qatar (414), Chile (412), Uruguay (409), Malaysia (409), Montenegro (406)

Base: All education systems with average scores over 400 in mathematics in PISA 2022
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

2.5 Mathematics performance over time

Learners in Wales achieved an average score of 487 in mathematics in PISA 2018, an average score of 478 in PISA 2015, and an average score of 468 in PISA 2012 when mathematics was last the major domain.

Wales was similar to the OECD trend average in 2018 for the first time. In 2015 and 2012 Wales was significantly below the OECD average. The trends over time in mathematics scores in Wales, New Zealand, Norway, the Republic of Ireland, Croatia and on average across current OECD countries in PISA 2022 are shown in Figure 2.1.

Figure 2.1: Trends in mathematics in Wales, comparator countries and on average across OECD trend countries

Overall average mathematics score
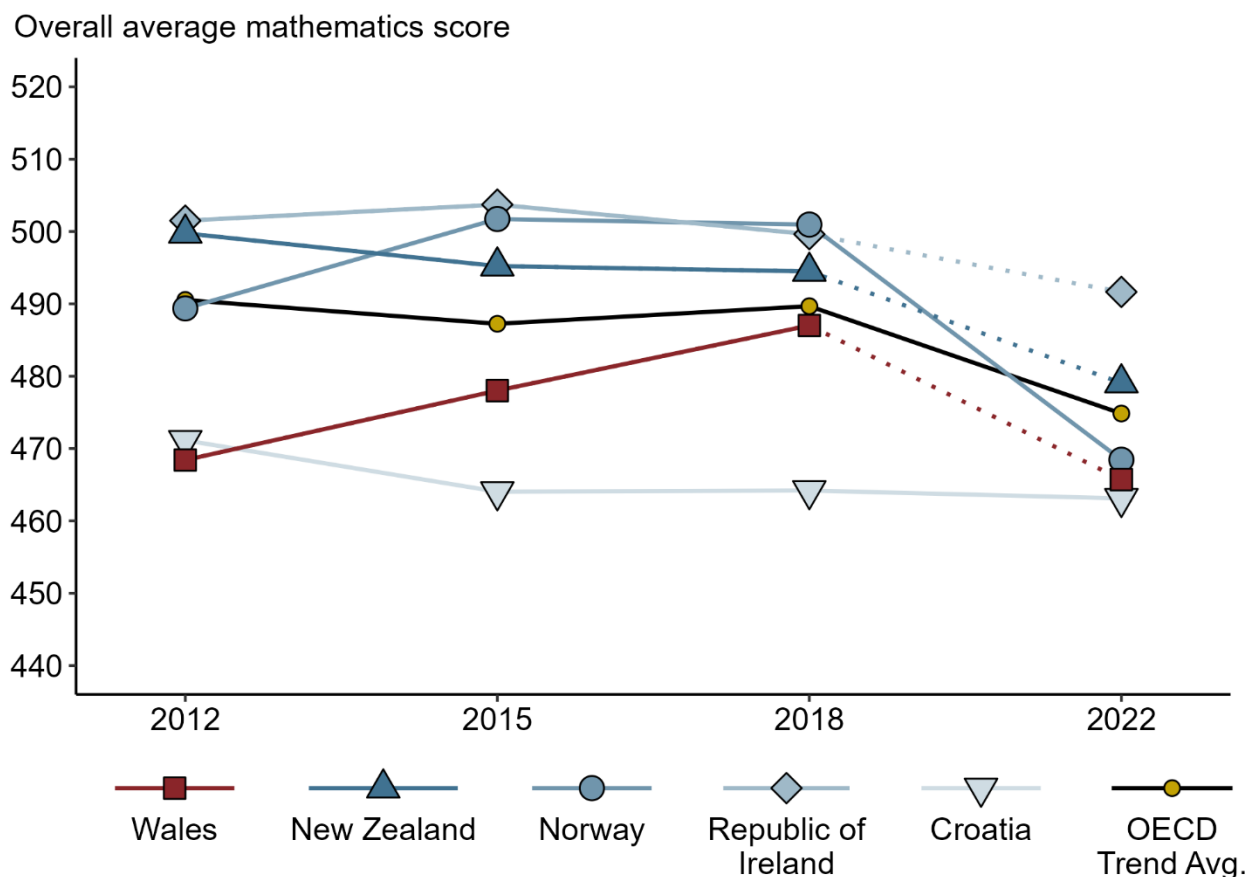
Country	2012	2015	2018	2022
Wales	468	* 478	* 487	466
New Zealand	* 500	* 495	* 494	479
Norway	* 489	* 502	* 501	468
Republic of Ireland	* 501	* 504	* 500	492
Croatia	471	464	464	463
OECD Trend Average	* 491	* 487	* 490	475

Asterisks (*) indicate that the score shown is significantly different to that country's score for PISA 2022. Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

In Wales' PISA 2018 National Report (Sizmur et al., 2019) the average score in mathematics was reported as 487 which was also not statistically significantly different from the OECD average score in that cycle of 489, or the OECD trend average of 490. Both Wales' average score and the OECD trend average score were significantly lower in 2022 than in 2018.

In total 41 of the 72 education systems that participated in both 2018 and 2022 saw a significant decrease in their average mathematics score in 2022 with only 7 education systems seeing a significant increase. The remaining 24 education systems saw no significant change in their scores.

Table 2.2 shows the changes in average mathematics scores between PISA 2022 and PISA 2018 for each education system that participated in both cycles of PISA and scored above 450 in mathematics in PISA 2022. Only 1 education system, Taiwan, scored significantly higher in mathematics in PISA 2022 than in PISA 2018 with an increase of 16 score points. In contrast, 26 education systems including Wales saw a significant decrease in their average mathematics score in 2022 compared to 2018. There were no statistically significant differences between their scores in PISA 2018 and PISA 2022 for 10 education systems.

Of the 35 OECD trend countries in 2022 that participated in PISA 2018, 27 had an average mathematics score in 2022 significantly lower than their average score in 2018, with 8 OECD trend countries having an average mathematics score that was not significantly different.

In 2022 mathematics was the major domain for PISA. The last time that mathematics was the major domain was in 2012. Macao was the only high-performing education system[7] that participated in PISA 2012 and PISA 2022 that had an average mathematics score that was significantly higher in 2022 than in 2012. There were 9 education systems as well as Wales where there was no significant difference between the average mathematics score in PISA 2022 and PISA 2012. New Zealand (−21), Norway (−21) and the Republic of Ireland (−10) each had higher average scores in mathematics in PISA 2012 than in PISA 2022. There were no significant differences between the average mathematics scores in Croatia (−8) between PISA 2012 and PISA 2022.

---

[7] Education systems with an average mathematics score above 450.

Table 2.2: Changes in mathematics average score in PISA 2022 relative to performance in PISA 2018 for higher-performing education systems

Trend in mathematics performance	Education system and change in score
Scored significantly higher in mathematics in PISA 2022 than in PISA 2018	Taiwan (16)
Scored significantly lower in mathematics in PISA 2022 than in PISA 2018	Iceland (−36), Norway (−33), Poland (−27), Netherlands (−27), Germany (−25), Slovenia (−24), Finland (−23), Slovakia (−22), France (−21), Sweden (−21), Portugal (−21), Wales (−21), Denmark (−20), Belgium (−19), New Zealand (−15), Italy (−15), Canada (−15), Estonia (−13), United States (−13), Latvia (−13), Czech Republic (−12), Austria (−12), Hong Kong (−11), Hungary (−8), Republic of Ireland (−8), Macao (−6)
No statistically significant differences in mathematics average scores between PISA 2022 and PISA 2018	Japan (+9), Singapore (+6), South Korea (+1), Turkey (+0), Croatia (−1), Australia (−4), Israel (−5), Malta (−6), Lithuania (−6), Switzerland (−7)

Base: All education systems with average scores over 450 in mathematics in PISA 2022 that also participated in PISA 2018.
Change in mathematics score (2022 score – 2018 score) presented in parenthesis.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

2.6 Differences between the highest- and lowest-performing learners in mathematics

It is important to examine the difference in performance between the highest and lowest performers in mathematics. This is because even where two countries have similar average scores in mathematics there may be significant differences in how their learners are performing across the attainment range. For example, a country with a wide spread of attainment may have a relatively high proportion of learners who are performing at the lowest levels and a high proportion of learners performing at the highest levels. They will have greater disparity across their population of learners. On the other hand, a country with a lower spread of attainment may have fewer very high performing learners but may also have fewer lower performing learners – they will have less disparity across their learners. Despite these differences, it would be possible for these two countries to obtain the same average score, masking important differences between the two.

The first way in which the spread of performance in each country can be examined is by looking at the distribution of scores. The 90th percentile is the score above which the

highest-performing 10% of learners obtain, while the 10th percentile is the score below which the lowest-performing 10% of learners obtain. The difference between the highest- and lowest-performers at the 90th and 10th percentiles is a better measure of the spread of scores for comparing countries than using the very highest- and lowest-performing learners as the latter comparison may be affected by a small number of learners with unusually high or low scores.

The gap between Wales' highest- and lowest-performing learners was 233 score points. This was not statistically significantly different from the OECD average of 235 score points. The performance gap between Wales' highest- and lowest-performing learners in 2018 was 211 score points when the difference was statistically significantly smaller than the OECD trend average of 237 score points.

Figure 2.2 shows the trend in the distribution of PISA mathematics scores in Wales since PISA 2012. The gap between Wales' highest- and lowest-performing learners in mathematics in PISA 2022 is statistically significantly larger than the gap in PISA 2018, PISA 2015 and PISA 2012.

The score at the 90th percentile in mathematics in Wales was 584. The score at the 10th percentile was 351 score points. On average across OECD countries the score at the 90th percentile in mathematics was 590 and the score at the 10th percentile was 355. These scores are not statistically significantly different from the respective scores in Wales.

Figure 2.2: Trends in the gap in mathematics performance between the highest- and lowest-performing learners in Wales
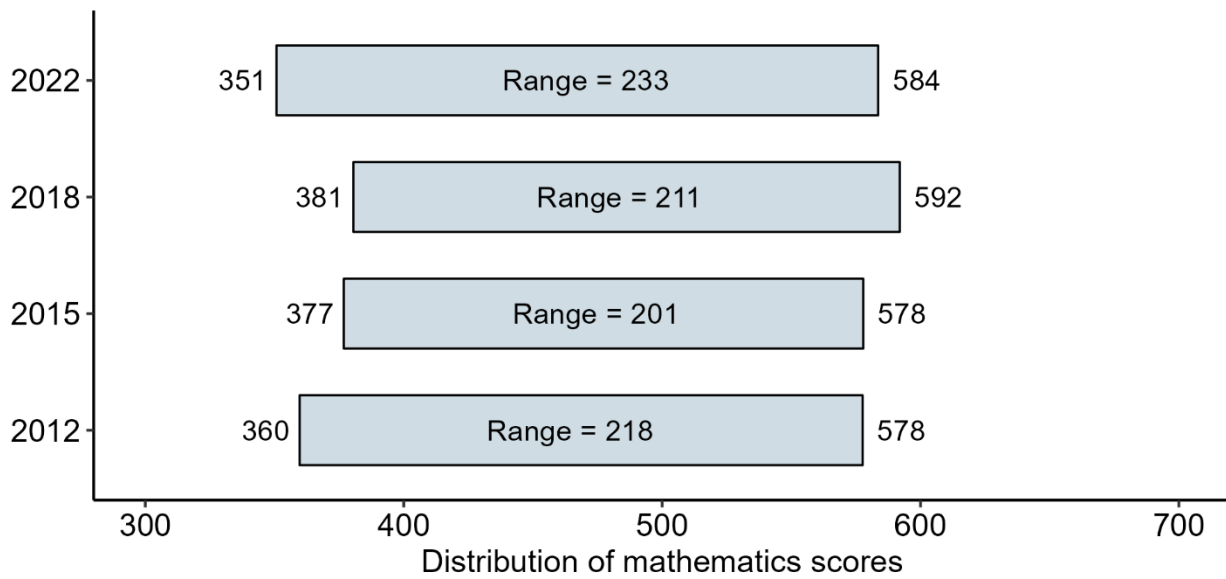
PISA Cycle	10th percentile	90th percentile	Range
2022	351	584	233
2018	381	592	211
2015	377	578	201
2012	360	578	218

Base: All participating learners in Wales.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

To further consider the differences between the highest- and the lowest-performing learners in mathematics in Wales, scores at the 90th and 10th percentiles can be compared with those of other education systems. The performance gap in mathematics in the United States (246), Norway (244) and Croatia (230) were not statistically significantly different from the performance gap in mathematics in Wales. In New Zealand, the performance gap in mathematics (258) was statistically significantly larger than in Wales. Figure 2.3 shows the differences between learners performing at the 90th and the 10th percentiles in all education systems with a mathematics score of 450 score points or above.

Figure 2.3: Gap in mathematics performance across higher-performing education systems

Performance gap (90th percentile score - 10th percentile score)
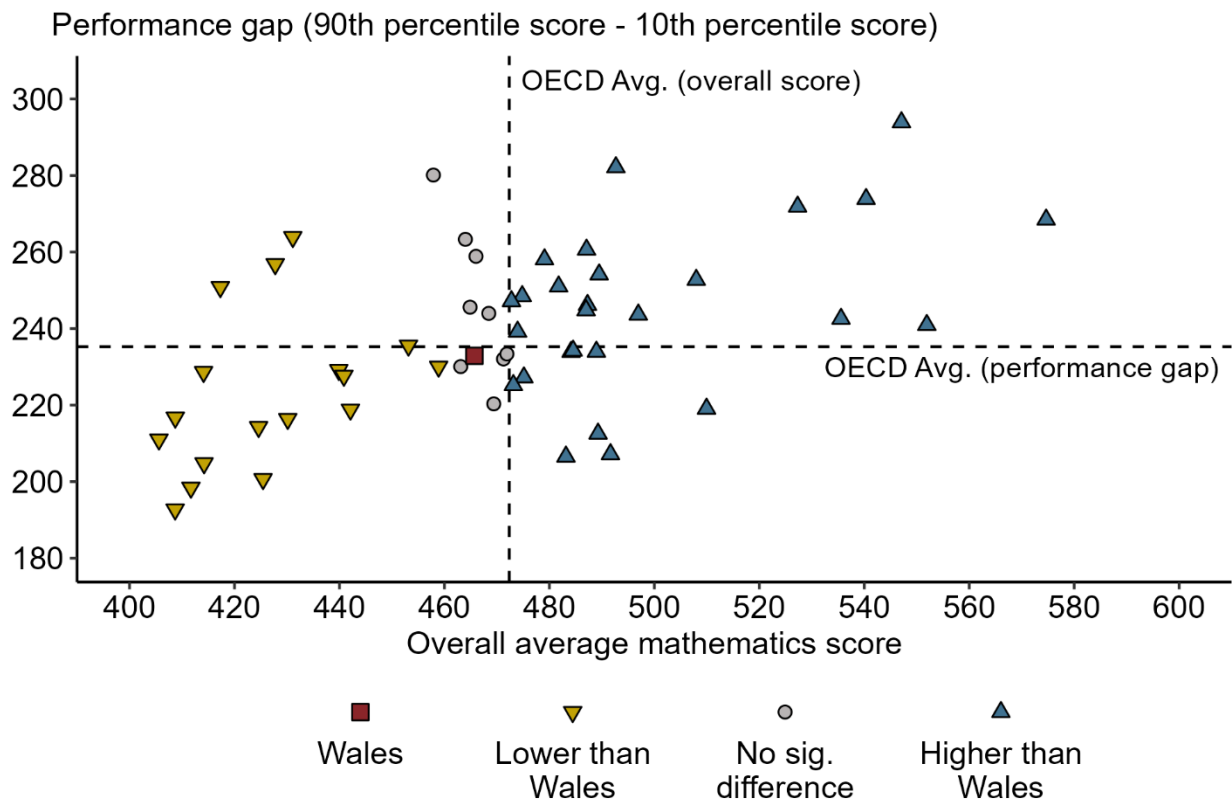
Base: Countries with an overall mathematics score of 400 score points or above
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

While there have been no significant differences in Wales in the score at the 90th percentile in mathematics since PISA 2012, in Norway there was a statistically significant decrease in the lowest score of their highest-performing learners between 2018 and 2022. The 90th percentile score for Norway in 2022 was 589 which is statistically significantly lower than the score in 2018 (617), 2015 (610) and 2012 (604). There were no significant differences between 2018 and 2022 for the score at the 90th percentile in New Zealand, Croatia and the Republic of Ireland. Trends in the performance at the 90th percentile across the 4 most recent cycles of PISA for Wales, New Zealand, Norway, the Republic of Ireland, Croatia and on average across OECD countries are shown in Figure 2.4.

Figure 2.4: Trends in mathematics performance at the 90th percentile for Wales, comparator countries and on average across OECD trend countries

Mathematics score (90th percentile)
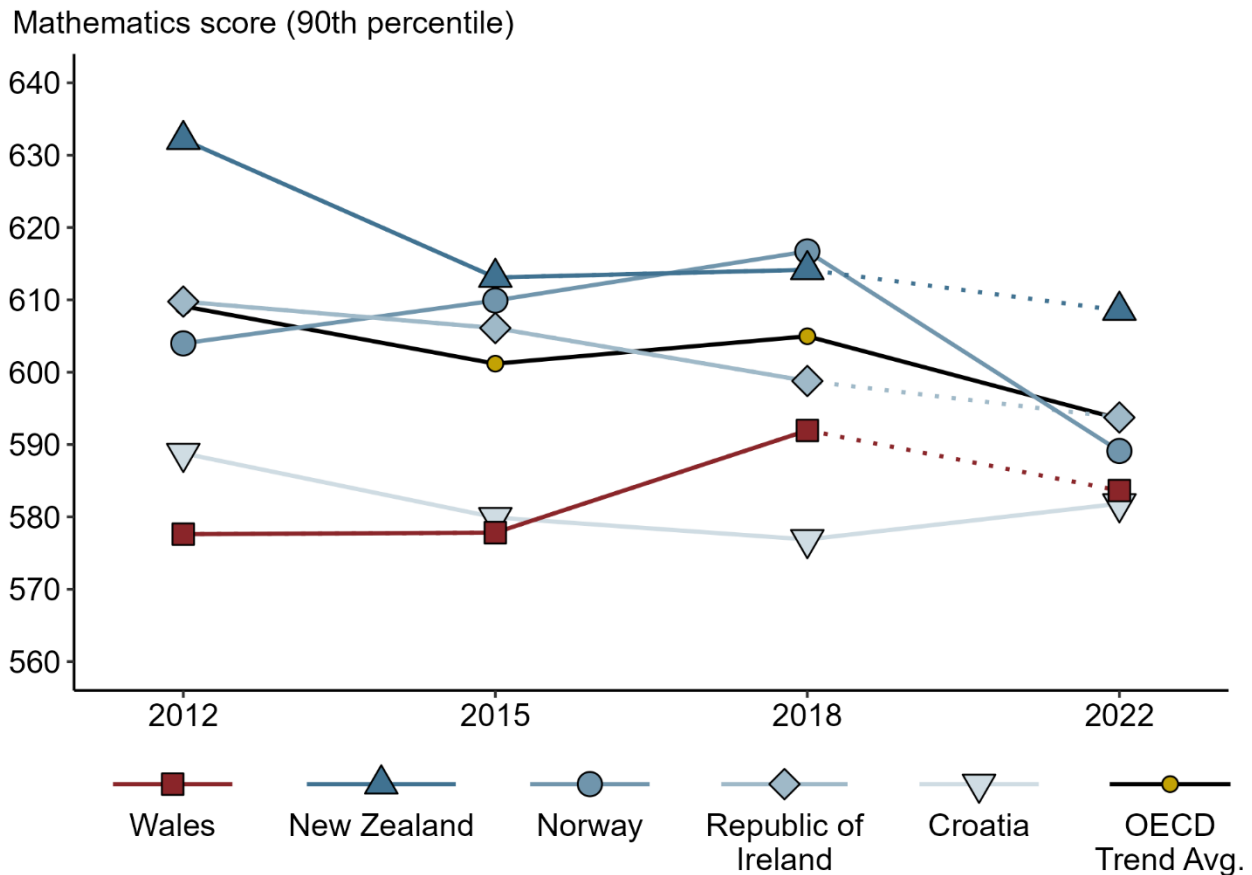
Country	2012	2015	2018	2022
Wales	578	578	592	584
New Zealand	* 632	613	614	609
Norway	* 604	* 610	* 617	589
Republic of Ireland	* 610	* 606	599	594
Croatia	589	580	577	582
OECD Trend Average	* 609	* 601	* 605	594

Base: All participating learners
Asterisks (*) indicate that the score shown was significantly different to that country's score for PISA 2022.
Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure.
OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

In Wales, the highest score of the lowest 10% of learners in 2022 (351) was significantly lower than in 2018, where the score was 381. There was also a statistically significant decrease in the score at the 10th percentile between 2022 and 2018 in New Zealand, Norway and the Republic of Ireland. In contrast, in Croatia there was no statistically significant difference between 2018 and 2022 for the highest score of the lowest-

performing learners. Trends in the performance at the 10th percentile across the 4 most recent cycles of PISA for Wales, New Zealand, Norway, the Republic of Ireland, Croatia and on average across OECD countries are shown in Figure 2.5.

Figure 2.5: Trends in mathematics performance at the 10th percentile for Wales, comparator countries and on average across OECD trend countries

Mathematics score (10th percentile)
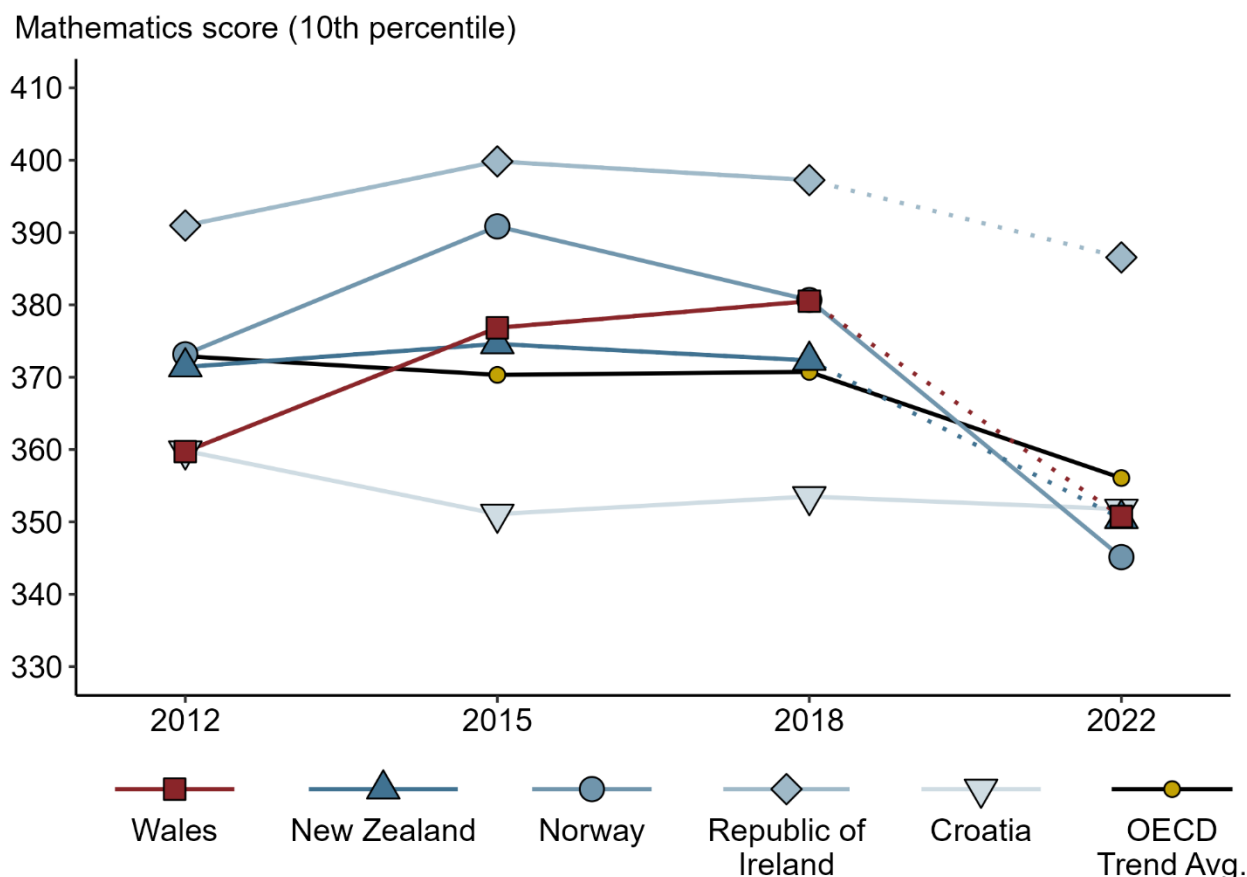
Country	2012	2015	2018	2022
Wales	360	* 377	* 381	351
New Zealand	* 371	* 375	* 372	350
Norway	* 373	* 391	* 381	345
Republic of Ireland	391	* 400	* 397	387
Croatia	360	351	354	352
OECD Trend Average	* 373	* 370	* 371	356

Base: All participating learners
Asterisks (*) indicate that the score shown was significantly different to that country's score for PISA 2022. Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

2.7 Performance across mathematics proficiency levels

Another way of examining the spread of performance is by looking at Wales' performance at each of the PISA proficiency levels. The PISA proficiency levels describe the tasks that learners performing at each level can do. They are devised internationally and are illustrated in the International Report (OECD, 2023e). Mathematics performance in PISA is described in terms of 8 proficiency levels (Levels 1-6, with Level 1 subdivided in 1a, 1b and 1c). These performance levels are outlined in the PISA 2022 Assessment and Analytical Framework (OECD, 2023b, p.49). Learners who score below Level 2 are considered low performers and those that perform at Level 5 or above are considered top performers. Level 2 is considered the baseline level of proficiency in mathematics where learners can begin to use mathematics in simple real-life situations, which is needed to participate fully in society.

In total 6% of learners in Wales performed at Levels 5 or 6, significantly less than the OECD average of 9%. The proportion of top-performing learners in Croatia, the Republic of Ireland and Norway were also not statistically significantly different from the proportion in Wales. A statistically significantly larger proportion of learners in New Zealand (10%) were top performers compared to the proportion of learners in Wales.

Wales had 32% of learners working at the lowest proficiency levels (below level 2) which was not significantly different from the OECD average of 31%. The proportion of learners not achieving this baseline proficiency level in Croatia (33%), New Zealand (29%) and Norway (31%) was not statistically significantly different from the proportion in Wales. The proportion of learners in the Republic of Ireland performing below the baseline proficiency level (19%) was statistically significantly smaller than the proportion in Wales.

The distribution of learners achieving each of the proficiency levels for mathematics in PISA 2022 in Wales, New Zealand, Norway, the Republic of Ireland, Croatia and on average across OECD trend countries is shown in Figure 2.6.

In Wales, the proportion of learners at the highest proficiency levels is similar to the proportions in 2018 and 2015 of 7% and 5% respectively. However, the proportion of learners performing below the baseline proficiency level has increased from 21% in 2018, this increase is statistically significant. On average across OECD trend countries the proportion of top-performing learners in mathematics in PISA 2022 (9%) was statistically significantly smaller than the proportions in 2018 (11%), 2015 (10%) and 2012 (12%). Similarly, the proportion of learners performing below Level 2 on average across OECD trend countries was statistically significantly larger in 2022 (30%) than in 2018 (24%), 2015 (25%) and 2012 (24%).

Figure 2.6: Percentage of learners in Wales, comparator countries and on average across OECD countries performing at each mathematics proficiency level
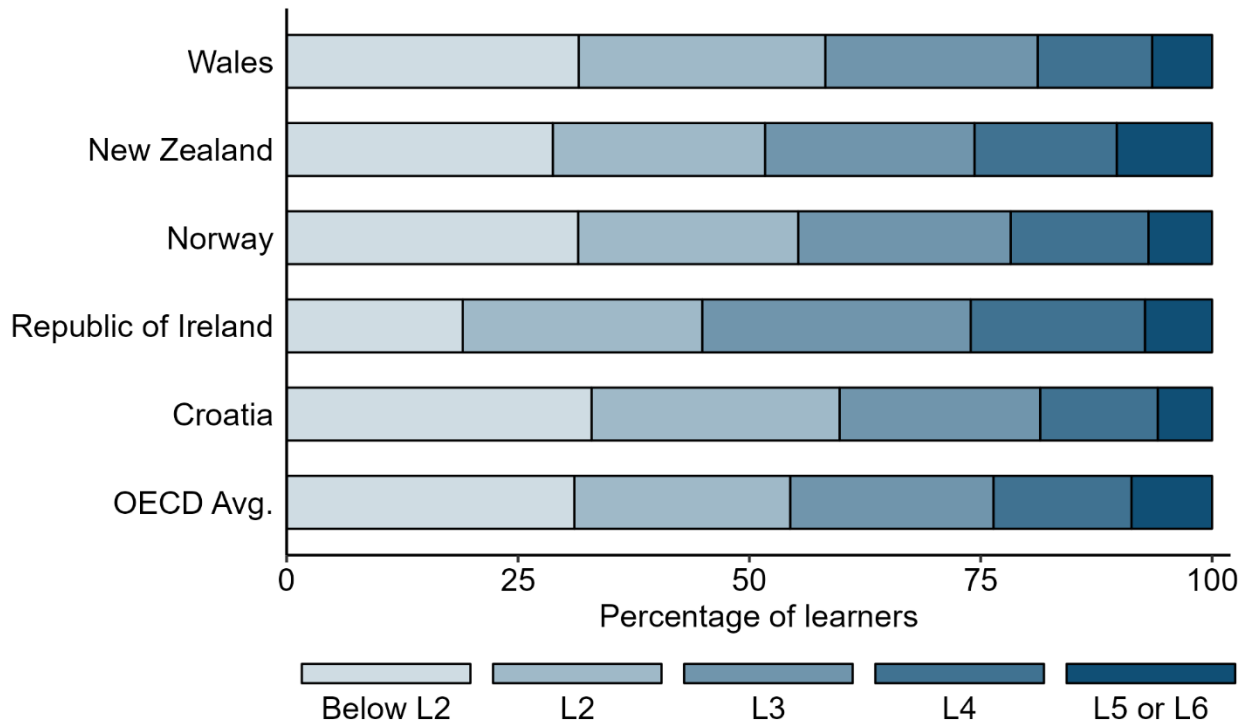
Country	Below L2	L2	L3	L4	L5 or L6
Wales	32%	27%	23%	12%	6%
New Zealand	29%	23%	23%	15%	10%
Norway	31%	24%	23%	15%	7%
Republic of Ireland	19%	26%	29%	19%	7%
Croatia	33%	27%	22%	13%	6%
OECD average	31%	23%	22%	15%	9%

Base: All participating learners in included education systems
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

3 Performance in mathematics subscales

3.1 Chapter overview

This chapter reports the performance of learners in Wales in the mathematics content and process category scale scores. It draws on findings outlined in the international report (OECD, 2023e) and places outcomes for Wales in the context of those findings. Caution needs to be taken in interpreting these findings as some of the sampling standards for PISA 2022 were not met in Wales as described in Chapter 1.

3.2 Key findings

- Learners in Wales had a higher average score for the uncertainty and data category (475) than for the other content categories assessed in PISA 2022. This was also the only category where the average performance of learners in Wales was not statistically significantly lower than on average across OECD countries.

- The average scores across each of the process domains of mathematical reasoning, formulating, employing and interpreting were broadly similar and all of them were lower than the average scores across OECD countries.

- In Wales, there were no statistically significant differences in the performance gap between the highest-performing learners (those performing above the 90th percentile) and the lowest-performing learners (those performing below the 10th percentile) between each of the content subscales.

- A significantly larger proportion of learners in Wales achieved the highest proficiency levels (Level 5 or 6) in the uncertainty and data category (10%) than in the space and shape category (5%) or the quantity category (7%).

- A significantly larger proportion of learners also achieved the highest proficiency levels in the change and relationships category (8%) than in the space and shape category (5%).

- In general, learners in Wales performed similarly across each of the process subscales at the highest and the lowest proficiency levels, with no statistically significant differences between the proportions of learners achieving a Level 5 or above, and no statistically significant differences between the proportions of learners performing below the baseline level.

3.3 Introduction to the subdomains

Mathematical literacy in PISA 2022 is assessed in relation to 4 content categories (change and relationships, quantity, space and shape, and uncertainty and data) and 4 process categories (mathematical reasoning, formulating, employing, and interpreting).

The process category of mathematical reasoning was introduced in PISA 2022. The remaining process categories and all the content categories were included in the previous mathematics assessment frameworks. The categories are described in further detail below and in the PISA 2022 mathematics framework (OECD, 2023c).

In addition to their overall performance, learners' performance in mathematics was analysed separately for each of the categories. In some education systems, learners showed notably stronger or weaker performance in some of these areas relative to their average performance. Differences between average scores on these subscales could have implications for teaching and learning or might reflect differences in the balance of these content areas across different curricula.

We are able to draw somewhat stronger conclusions when comparing across subscales within Wales because we are not trying to generalise beyond the sample of learners in Wales. The fact that the sample deviates from the sampling standards has less of an influence because the comparison is taking place within it, rather than between it and samples from previous years or from other education systems. In other words, the subscales within Wales that are being compared are equally affected by the sampling deviations.

3.4 Mathematics content subdomain scale scores

The 4 mathematics content category scales include change and relationships, quantity, space and shape, and uncertainty and data. These are described below.

3.4.1 Change and relationships

The change and relationships category involves learners demonstrating their understanding of types of change and recognising when they occur. This can involve the use of suitable mathematical models to both describe the changes and relationships but also to predict change. It also requires the use of appropriate functions and equations to model the change and the relationships, as well as moving between and interpreting different representations of these changes and relationships.

In 2022, Wales' average score for the change and relationships category was 465 which was significantly lower than the average of 470 across OECD countries. Learners in Croatia and Norway achieved an average score for the change and relationships category that was not statistically different from Wales, 465 in both cases. The average scores of 492 in the Republic of Ireland and 476 in New Zealand were both statistically significantly higher than the average scores of learners in Wales for the change and relationships category in PISA 2022.

3.4.2 Quantity

Quantity 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. The essence of mathematical literacy relative to quantity include number sense, multiple representations of numbers, elegance in computation, mental calculation, estimation and the assessment of the reasonableness of results. This category includes applying knowledge of number and number operations in a wide variety of settings.

Wales' average score for the quantity category was 462 which was statistically significantly lower than the OECD average of 472. There was no statistically significant difference between the average scores in the quantity category of learners in Croatia (464), Norway (469) and Wales. Learners in New Zealand and the Republic of Ireland had a statistically significantly higher average score in the quantity category than learners in Wales, with average scores of 478 and 494 respectively.

3.4.3 Space and shape

Space and shape involves a wide range of phenomena that are encountered in our visual and physical world. This includes patterns, properties of objects, positions and orientations, representations of these objects, decoding and encoding of visual information, navigation and dynamic interaction with real shapes as well as with representations, movement, displacement, and the ability to anticipate actions in space. Being literate in the shape and space category involves understanding perspective and interpreting views of three-dimensional shapes from different perspectives, as well as constructing and transforming representations of shapes. It also includes creating and reading maps.

Wales' average score for the space and shape category was 451, significantly lower than the OECD average score for space and shape of 471, and the average score of learners in New Zealand (473), Norway (469) and the Republic of Ireland (474). There was no statistically significant difference between the average score of learners in Croatia (455) and the average score of learners in Wales in the space and shape category.

3.4.4 Uncertainty and data

Uncertainty is a phenomenon at the heart of the mathematical analysis of many problem situations. The uncertainty and data content category includes recognising the place of variation in processes, having a sense of the quantification of that variation, acknowledging uncertainty and error in measurement, and knowing about chance.

Wales' average score for the uncertainty and data category was 475, not significantly different from the OECD average of 474, or the average score of learners in Norway (470). The average scores for the uncertainty and data category in New Zealand (486) and in the Republic of Ireland (499) were both statistically significantly higher than the

average score in Wales. In contrast, the average score in Croatia of 463 score points was statistically significantly lower than the average score in Wales.

3.4.5 Differences between content subdomain scores

In Wales, the highest average content subdomain score was for uncertainty and data category. This was also the case in New Zealand, the Republic of Ireland, Norway and on average across OECD countries, although not all of these are significantly higher than the other subdomain scores. The lowest average subdomain score in Wales was for space and shape, which was also the lowest average subdomain score in New Zealand, the Republic of Ireland and Croatia, though not all of these are significantly lower than the other subdomain scores. On average across OECD countries the difference between the highest average content subdomain score (uncertainty and data) and the lowest average content subdomain score (change and relationships) was 4 score points. In Wales, this difference was 24 score points between uncertainty and data and space and shape. This is similar to the difference in the Republic of Ireland (25 score points). The largest difference in New Zealand was also between the uncertainty and data category and the space and shape category (13 score points). The distribution of the content subdomain scores in Wales, across the comparator countries and on average across the OECD countries is shown in Figure 3.1.

Figure 3.1: Distribution of the average scores for each content subdomain for Wales, comparator countries and on average across OECD countries
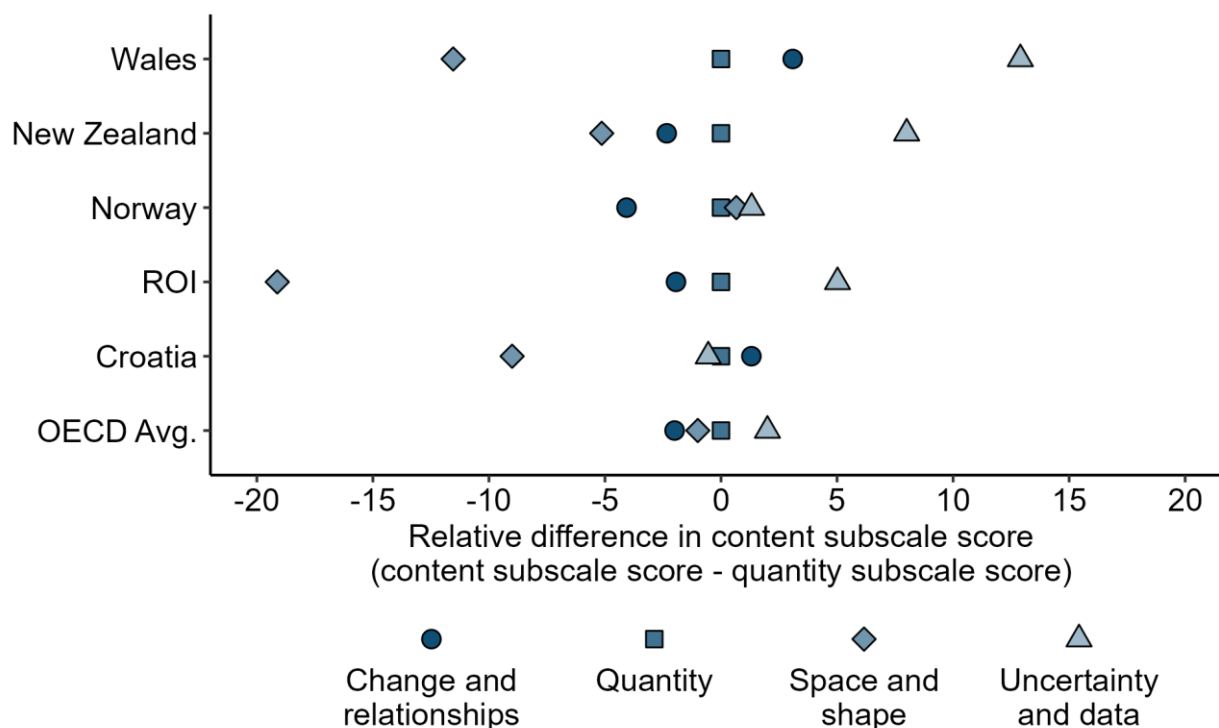
Country	Change and relationship	Quantity	Space and shape	Uncertainty and data
Wales	465	462	451	475
New Zealand	476	478	473	486
Norway	465	469	469	470
Republic of Ireland	492	494	474	499
Croatia	465	464	455	463
OECD average	470	472	471	474

Base: All participating learners in Wales
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included countries. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

3.4.6 Differences between the highest- and lowest-performing learners in the content subscales

In Wales, there were no statistically significant differences in the performance gap between the highest-performing learners (those performing above the 90th percentile) and the lowest-performing learners (those performing below the 10th percentile) between each of the content subscales. The score at the 90th percentile in the uncertainty and data category in Wales (606) was statistically significantly higher than the scores at the

90th percentile in the quantity category (588) and the space and shape category (573). The score at the 90th percentile in the space and shape category (573) was also statistically significantly lower than the score at the 90th percentile in Wales in the change and relationships category (593). There were no statistically significant differences in the scores at the 10th percentile in each content category.

In respect to the PISA proficiency levels, a statistically significantly larger proportion of learners in Wales achieved the highest proficiency levels (Level 5 or 6) in the uncertainty and data category (10%) than in the space and shape category (5%) or the quantity category (7%). A statistically significantly larger proportion of learners also achieved the highest proficiency levels in the change and relationships category (8%) than in the space and shape category. On average across OECD countries, 10% of learners performed at proficiency level 5 or above in the change and relationships, quantity and space and shape categories and 11% of learners performed at proficiency level 5 or above in the uncertainty and data category. The proportion of learners at the highest proficiency levels in Wales, comparator countries and on average across OECD countries are summarised in Table 3.1.

A similar proportion of learners in the Republic of Ireland (8%), Croatia (7%) and Norway (7%) performed at the highest proficiency levels in the change and relationships category to the proportion of learners in Wales. A statistically significantly larger proportion of learners in New Zealand performed at the highest proficiency levels than in Wales in all 4 of the content categories, with 11% of learners in the change and relationships category and the quantity category, 9% in the space and shape category and 14% in the uncertainty and data category. There were no statistically significant differences in the proportion of learners achieving the highest proficiency levels in Croatia and the proportion of learners in Wales except in the uncertainty and data subdomain. The proportion of learners in the Republic of Ireland performing at the highest proficiency levels in the quantity category (10%) was statistically significantly larger than the proportion of learners in Wales, as was the proportion of learners in Norway in the space and shape category (8%). There were no statistically significant differences in the proportion of learners in the Republic of Ireland or in Norway in the change and relationship category (8% and 7% respectively) or in the uncertainty and data category (12% and 10% respectively) achieving the highest proficiency levels in relation to the respective proportions in Wales.

Table 3.1: Proportion of learners at the highest proficiency levels in the content subdomains in Wales, comparator countries and on average across OECD countries

Category	Change and relationships	Quantity	Space and shape	Uncertainty and data
Wales	8%	7%	5%	10%
New Zealand	11%	11%	9%	14%
Norway	7%	8%	8%	10%
Republic of Ireland	8%	10%	5%	12%
Croatia	7%	7%	6%	7%
OECD average	10%	10%	10%	11%

Base: All participating learners in Wales
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included countries. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

The proportion of learners in Wales performing below the baseline level (Level 2) was statistically significantly smaller for the uncertainty and data category (30%) and the quantity category (34%) than the space and shape category (38%), The proportion of learners performing below the baseline level in the change and relationships category was 33%. Around one-third of learners on average across OECD countries performed below the baseline proficiency level (Level 2), with 33% of learners for the change and relationships category, and 32% of learners for the quantity, space and shape, and uncertainty and data categories. These were not statistically significantly different from the proportion of learners in Wales except in the space and shape domain where a larger proportion of learners in Wales performed below the baseline level than on average across OECD countries.

The proportion of learners in the Republic of Ireland performing below the baseline proficiency level (Level 2) was statistically significantly smaller than the proportion of learners in Wales for each of the content categories, with 20% of learners in the change and relationships category, 21% in the quantity category, 25% in the space and shape category, and 19% in the uncertainty and data category. In the space and shape category, the proportion of learners performing below the baseline level in New Zealand (31%) and Norway (32%) were both statistically significantly smaller than the proportion of learners in Wales (38%). There were no statistically significant differences in the proportion of learners in Croatia achieving below the baseline level in any of the categories and the proportion of learners in Wales. There were also no statistically significant differences in the proportion of learners in Norway or New Zealand achieving

below the baseline level in the change and relationships category or the uncertainty and data category and the proportion of learners in Wales.

Table 3.2: Proportion of learners performing below the baseline proficiency level in the content subdomains in Wales, comparator countries and on average across OECD countries

Category	Change and relationships	Quantity	Space and shape	Uncertainty and data
Wales	33%	34%	38%	30%
New Zealand	31%	30%	31%	28%
Norway	33%	32%	32%	33%
Republic of Ireland	20%	21%	25%	19%
Croatia	33%	34%	37%	33%
OECD average	33%	32%	32%	32%

Base: All participating learners in Wales
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included countries. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

3.5 Mathematics processes category scale scores

3.5.1 Mathematical reasoning

The mathematical reasoning category was new for PISA 2022. It focuses on learners' ability to reason logically and present arguments. This category involves 6 key understandings that include:

- 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

In Wales, the average score for the mathematical reasoning category was 467 which was statistically significantly lower than the OECD average of 473. Learners in New Zealand, Norway, and the Republic of Ireland performed on average significantly higher in this category than learners in Wales, with average scores of 481, 476 and 490 respectively.

On the other hand, there was no significant difference between the average score of learners in Croatia (466) and learners in Wales.

3.5.2 Formulating

The formulating category focuses on the ability of learners to recognise and identify opportunities to use mathematics and then provide mathematical structure to a problem presented in some contextualised form. In the process of formulating situations mathematically, learners need to determine where they can extract the essential mathematics to analyse, set up and solve the problem. They also need to be able to translate from a real-world setting to the domain of mathematics and provide the real-world problem with mathematical structure, representations and specificity. They also need to reason about and make sense of constraints and assumptions in the problem.

In Wales, the average score for the formulating category was 461 which was statistically significantly lower than the OECD average of 469. There was no statistically significant difference between the average scores in the formulating category for learners in Croatia (455) or learners in Norway (465) and the average score for learners in Wales.

3.5.3 Employing

The employing category focuses on learners' ability to apply mathematical concepts, facts, procedures and reasoning to solve mathematically formulating problems to obtain mathematical conclusions. In the process of employing mathematical concepts, facts, procedures and reasoning to solve problems, learners need to perform the mathematical procedures needed to derive results and find a mathematical solution. They work on a model of the problem situation, establish regularities, identify connections between mathematical entities and create mathematical arguments.

Learners in Wales achieved an average score of 464 in the employing category which was statistically significantly lower than the OECD average of 472. Learners in New Zealand and in the Republic of Ireland also had statistically significantly higher scores than learners in Wales with average scores in the employing category of 477 and 494 respectively. There was no statistically significant difference in the performance of learners in Croatia or in Norway and learners in Wales for the employing category, with an average score of 463 in Croatia and an average score of 466 in Norway.

3.5.4 Interpreting

The interpreting category focuses on the ability of learners to reflect upon mathematical solutions, results or conclusions and interpret and evaluate them in the context of the real-life problem that initiated the process. This involves translating mathematical solutions or reasoning back into the context of the problem and determining whether the results are reasonable and make sense in the context of the problem.

In the interpreting category, learners in Wales achieved an average score of 467 which was statistically significantly lower than the OECD average of 474. This average score for learners in Wales is not statistically significantly different from the average score of learners in Croatia (467) or Norway (467). Learners in New Zealand and learners in the Republic of Ireland both had statistically significantly higher average scores in the interpreting category than learners in Wales, with average scores of 486 and 495 respectively.

3.5.5 Differences between process subdomain scores

In Wales, the highest average process subdomain score was for the interpreting and the mathematical reasoning categories. The interpreting subdomain was also the highest subdomain score in New Zealand, the Republic of Ireland, Croatia and on average across OECD countries, though it was not always significantly higher than the other process subdomain scores. In all of the comparator countries, in Wales, and on average across the OECD, the lowest average process subdomain score was in the formulating category, this was significantly lower than all the other subdomain scores in Croatia.

The difference between the highest process subdomain score and the lowest subdomain scores in Wales was 6 score points. On average across the OECD this difference was 5 score points. The distribution of the content subdomain scores in Wales, across the comparator countries and on average across the OECD countries is shown in Figure 3.2.

Figure 3.2: Distribution of the average scores for each process subdomain for Wales, comparator countries and on average across OECD countries
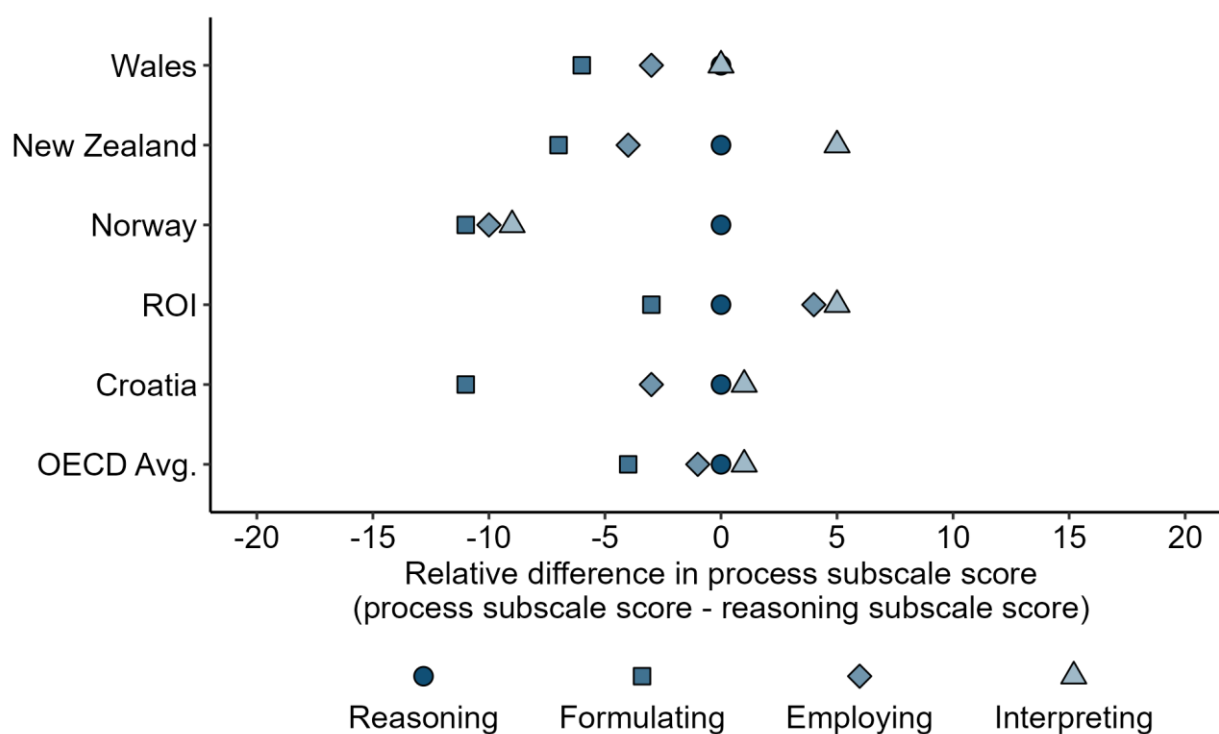
Country	Mathematical reasoning	Formulating	Employing	Interpreting
Wales	467	461	464	467
New Zealand	481	474	477	486
Norway	476	465	466	467
Republic of Ireland	490	487	494	495
Croatia	466	455	463	467
OECD average	473	469	472	474

Base: All participating learners in Wales
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included countries. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

3.5.6 Differences between the highest- and lowest-performing learners in the process subscales

In Wales, the performance gap between the highest-performing learners (above the 90th percentile) and the lowest-performing learners (below the 10th percentile) was significantly smaller in both the interpreting process category (239 score points) and the mathematical reasoning process category (235 score points) than in the formulating category (267 score points). The performance gap in the mathematical reasoning

process category was also significantly smaller than the performance gap for employing (254). There were also no significant differences between the performance gaps in each of the process subscales and the performance gaps on average across OECD countries.

In general, learners in Wales performed similarly across each of the process subscales at the highest and the lowest proficiency levels, with no statistically significant differences between the proportions of learners achieving a Level 5 or above, and no statistically significant differences between the proportions of learners performing below the baseline level.

The proportion of learners in Wales achieving proficiency level 5 or above was 8% in the formulating and employing categories, and 7% in the interpreting and mathematical reasoning categories. On average across OECD countries, 10% of learners performed at Level 5 or above in the formulating, employing and interpreting categories and 9% in the mathematical reasoning category. There were no significant differences between the proportion of learners in Wales achieving the highest proficiency levels in mathematics in the formulating subdomain, however a significantly larger proportion of learners on average across OECD performed at these higher levels than in Wales in the other three process domains.

Table 3.3: Proportion of learners at the highest proficiency levels in the process subdomains in Wales, comparator countries and on average across OECD countries

Category	Mathematical Reasoning	Formulating	Employing	Interpreting
Wales	7%	8%	8%	7%
New Zealand	10%	12%	12%	13%
Norway	8%	7%	8%	9%
Republic of Ireland	7%	9%	10%	9%
Croatia	6%	7%	7%	8%
OECD average	9%	10%	10%	10%

Base: All participating learners in Wales
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included countries. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

In New Zealand, a statistically significantly larger proportion of learners achieved the highest proficiency levels in each of the process categories compared to the proportion of learners in Wales, with 10% in mathematical reasoning, 12% in formulating and employing, and 13% in interpreting. A statistically significantly larger proportion of learners in the Republic of Ireland also performed at these highest levels in the

employing and interpreting categories, with 10% and 9% of learners respectively. There was no statistically significant difference in the proportion of learners in the Republic of Ireland and the proportion of learners in Wales achieving the highest proficiency levels in the formulating and reasoning categories. There were also no statistically significant differences in the proportion of learners achieving the highest proficiency levels in Croatia or in Norway than in Wales.

Overall 31% of learners in Wales performed below Level 2 for the mathematical reasoning process, with 32% in the interpreting process, 34% in the employing process and 35% in the formulating process achieving a score below Level 2. These are not significantly different to the proportions on average across OECD countries.

In the Republic of Ireland, the proportion of learners performing below the baseline proficiency level (Level 2) was statistically significantly smaller than in Wales in each of the process categories. There were no statistically significant differences in the proportions of learners performing at these lowest levels in each of the process categories in New Zealand, Norway or Croatia than in Wales, except in interpreting where a statistically significantly smaller proportion of learners in New Zealand performed below the baseline (27%) than in Wales (32%).

Table 3.4: Proportion of learners performing below the baseline proficiency levels in the process subdomains in Wales, comparator countries and on average across OECD countries

Category	Mathematical Reasoning	Formulating	Employing	Interpreting
Wales	31%	35%	34%	32%
New Zealand	28%	32%	31%	27%
Norway	29%	33%	33%	33%
Republic of Ireland	20%	23%	21%	19%
Croatia	32%	38%	34%	32%
OECD average	31%	34%	32%	31%

Base: All participating learners in Wales
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included countries. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 Database

4 Reading

4.1 Chapter overview

This chapter focuses on Wales' performance in the reading domain of PISA 2022, and how this compares to the performance of other education systems and to Wales' previous participations. This chapter also looks at the distribution of reading performance in Wales, the proportion of learners in Wales who performed at the different PISA proficiency levels in reading. Caution needs to be taken in interpreting these findings as some of the sampling standards for PISA 2022 were not met in Wales as described in Chapter 1.

4.2 Key findings

- In 2022, Wales' average score in reading (466) was significantly below the OECD average in reading (476). The average score in Wales was also significantly below the OECD trend average in the previous cycles of PISA in 2015 and 2012, but not significantly different to the OECD trend average in 2018.

- Of all other 78 participating education systems[8], Wales outperformed 45, was not significantly different to 6 and was significantly outperformed by 27.

- Wales' average score in reading in 2022 was significantly below the average score in 2018 (483), and the OECD trend average was also significantly lower in 2022 (477) than in 2018 (488).

- Over the period of 2012-2022, the performance of learners in reading has seen little change in Wales, but it has been in decline on average across the OECD trend countries. In 2022, Wales' average score was not significantly different to the score in 2012 (480), whereas the OECD trend average was significantly lower in 2022 (477) than in 2012 (494).

- The distribution of scores in Wales in 2022 is wider than in the previous cycles of PISA. This is due to a decrease in the score of lowest performing learners in the country while the scores of highest performing learners are broadly similar since 2012.

4.3 Introduction to reading in PISA

This chapter focuses on Wales' performance in the reading domain of PISA, looking at how Wales' performance in 2022 compares to that of other participating education

---

[8] International comparisons involving Wales in this report do not include Cyprus as these data were not available at the time of writing. Vietnam was also excluded from the analysis of reading performance as a strong linkage to the international PISA reading scale could not be established.

systems, as well as the range between the highest and lowest performing learners. The chapter also looks at historical trends in performance.

The framework for assessing learners' reading literacy was revised in PISA 2018, when reading was the major domain of assessment. The reading component of the PISA 2022 assessment aims to consider the learners' capacity to understand, use and reflect on written texts in order to achieve goals, to develop knowledge and potential, and to participate in society (OECD, 2023b).

As Wales' school-level and learner-level response rates did not meet some of the PISA sampling standards, caution is required when interpreting the analysis reported here. Cautious interpretation is particularly necessary when considering trends in performance over time and when making international comparisons. The Republic of Ireland, the Netherlands, and New Zealand, which have been included as comparator countries, also did not meet some of the PISA sampling standards as well as some of the other OECD countries included in the OECD averages. For more information see Section 1.4.2.

4.4 Wales' performance in reading

Wales' average score in reading in PISA 2022 was 466. This was significantly below the OECD average of 476. Table 4.1 shows Wales' performance relative to every other education system with average reading scores greater than 400. A total of 27 systems had average scores significantly above Wales, while 6 systems had average scores that were not significantly different to Wales. Every other education system had an average score in reading that was significantly below Wales.

The 6 highest performing systems in PISA 2022 were Singapore (543), the Republic of Ireland (516), Japan (516), South Korea (515), Taiwan (515) and Estonia (511). The highest-performing OECD countries were Japan and the Republic of Ireland.

Table 4.1: Reading performance of higher-performing education systems in PISA 2022 relative to Wales

Performance relative to Wales	Education system and average score
Education systems that scored significantly higher than Wales in reading in PISA 2022	Singapore (543), Republic of Ireland (516), Japan (516), South Korea (515), Taiwan (515), Estonia (511), Macao (510), Canada (507), United States (504), New Zealand (501), Hong Kong (500), Australia (498), Finland (490), Denmark (489), Poland (489), Czech Republic (489), Sweden (487), Switzerland (483), Italy (482), Austria (480), Germany (480), Belgium (479), Portugal (477), Norway (477), Croatia (475), Latvia (475)
Wales and education systems that did not score significantly higher or lower than Wales in reading in PISA 2022	France (474), Israel (474), Hungary (473), Lithuania (472), Slovenia (469), Wales (466), Netherlands (459)
Education systems that scored significantly lower than Wales in reading in PISA 2022	Turkey (456), Chile (448), Slovakia (447), Malta (447), Serbia (440), Greece (438), Iceland (436), Uruguay (430), Brunei Darussalam (429), Romania (428), Ukrainian regions (428), Qatar (419), United Arab Emirates (417), Mexico (415), Costa Rica (415), Moldova (411), Brazil (410), Jamaica (410), Colombia (409), Peru (408), Montenegro (405), Bulgaria (404), Argentina (401)

Base: All education systems with average scores over 400 in reading in PISA 2022.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

4.5   Reading performance over time

Wales' reading average score of 466 in PISA 2022 represents a drop of 18 score points (after taking into account the rounding of figures) from PISA 2018 (483). This decline was statistically significant. This trend was not unique to Wales, with the OECD trend average being also significantly lower in PISA 2022 (477) than in PISA 2018 (488). Out of 71 education systems that participated in both PISA 2018 and PISA 2022 including Wales, 6 education systems scored significantly higher in reading in PISA 2022 than in PISA 2018. By contrast, 37 education systems saw their reading average score significantly lower in PISA 2022 than in PISA 2018. Table 4.2 shows the changes in reading average score between PISA 2018 and PISA 2022 for every education system that participated in both PISA 2018 and PISA 2022 and scored above 400 in reading in PISA 2022.

Table 4.2: Changes in reading average score in PISA 2022 relative to performance in PISA 2018 for higher-performing education systems

Trend in reading performance	Education system and change in score
Scored significantly higher in reading in PISA 2022 than in PISA 2018	Brunei (+21), Taiwan (+13), Qatar (+12), Japan (+12)
Scored significantly lower in reading in PISA 2022 than in PISA 2018	Singapore (−7), Turkey (−10), Slovakia (−11), Costa Rica (−11), Estonia (−12), Denmark (−12), Canada (−13), Moldova (−13), Belgium (−14), United Arab Emirates (−14), Macao (−15), Portugal (−15), Bulgaria (−16), Montenegro (−16), Wales (−18), Germany (−18), France (−19), Sweden (−19), Greece (−19), Norway (−23), Poland (−23), Hong Kong (−25), Netherlands (−26), Slovenia (−27), Finland (−30), Iceland (−38), Ukrainian regions (−38)
No statistically significant differences in reading average score between PISA 2022 and PISA 2018	Peru (+8), Italy (+5), Israel (+3), Uruguay (+3), South Korea (+1), Serbia (+1), Romania (+1), Switzerland (−1), Argentina (−1), United States (−1), Czech Republic (−2), Republic of Ireland (−2), Spain (−2), Brazil (−3), Malta (−3), Hungary (−3), Croatia (−3), Colombia (−4), Austria (−4), Lithuania (−4), Latvia (−4), Chile (−4), Australia (−5), New Zealand (−5), Mexico (−5)

Base: All education systems with mean scores over 400 in reading in PISA 2022 that also participated in PISA 2018.
Change in reading score (2022 score – 2018 score) presented in parenthesis.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Figure 4.1 presents Wales' overall reading performance over the last 4 cycles of PISA relative to the comparator countries and to the OECD trend average. Wales' reading average score in PISA 2022 (466) was significantly lower than the score in 2018 (483), but not significantly different to the scores in 2015 (477) and 2012 (480). Looking at the comparator countries, the trajectories of overall reading performance of Netherlands and Norway showed downward trends from 2012 and 2015 respectively. Netherlands scored significantly lower in PISA 2022 (459) than in 2018 (485), 2015 (503) and 2012 (511), and Norway scored significantly lower in PISA 2022 (477) than in 2018 (499), 2015 (513) and 2012 (504). In the Republic of Ireland and New Zealand, the reading average score in PISA 2022 was not significantly different to the scores in 2018, 2015 and 2012.

On average across the OECD trend countries, the overall reading performance shows a downward trend since 2012. The OECD trend average in PISA 2022 (477) was significantly lower than the scores in 2018 (488), 2015 (490) and 2012 (494).

Figure 4.1: Trends in reading performance in Wales, comparator countries and on average across OECD trend countries

Overall average reading score
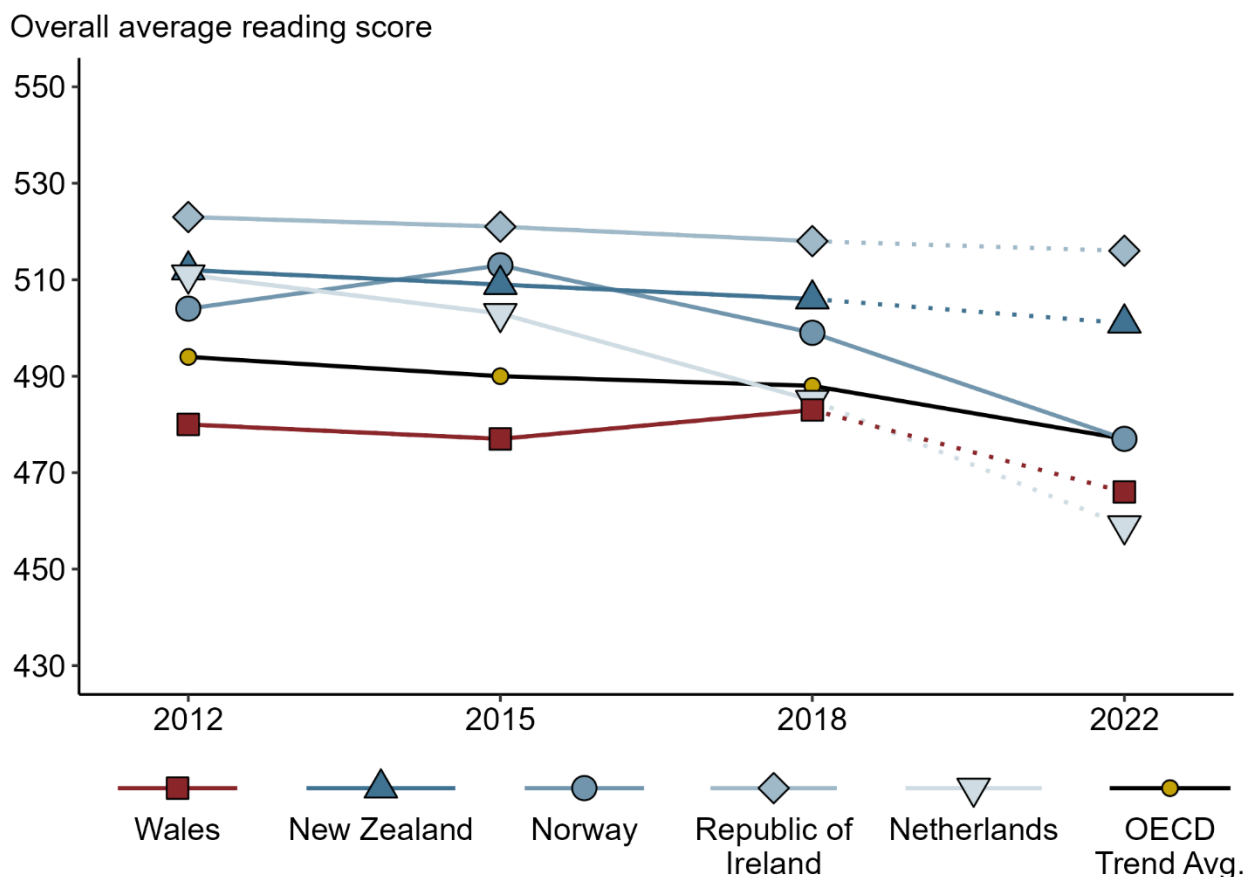
Country	2012	2015	2018	2022
Wales	480	477	* 483	466
Netherlands	* 511	* 503	* 485	459
New Zealand	512	509	506	501
Norway	* 504	* 513	* 499	477
Republic of Ireland (ROI)	523	521	518	516
OECD Trend Average	* 494	* 490	* 488	477

Asterisks (*) indicate that the score shown was significantly different to that system's score for PISA 2022. Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

4.6 Differences between the highest- and lowest-performing learners in reading

In this section, we look at the range of learners' performance in reading by discussing Wales' performance at the 90th and 10th percentiles. The 90th percentile was the score

above which the highest performing 10% of learners obtain, while the 10th percentile was the score below which the lowest performing 10% of learners obtain. The difference between the highest and lowest performers at the 90th and 10th percentiles was a better measure of the spread of scores for comparing countries than using the very highest and lowest performing learners, as the latter comparison may be affected by a small number of learners with unusually high or low scores.

There needs to be particular caution in interpreting the scores of the highest- and lowest-performing learners as the non-response bias analysis suggests that lower-performing learners may have been under-represented among learners who participated in PISA 2022.

Figure 4.2 shows the distribution of reading scores in Wales for each PISA cycle since 2012. Since 2015, there has been a widening in the distribution of reading scores in Wales. The range in reading scores in PISA 2022 (263) was significantly larger than the ranges in 2015 (219) and 2012 (228), but not significantly different to the range in 2018 (250). This increasing range can be explained by a 35 score point drop in the reading score at the 10th percentile, which was statistically significant, while the difference in the score at the 90th percentile between PISA 2022 (597) and 2015 (588) was not statistically significant.

Figure 4.2: Trends in the gap in reading performance in Wales
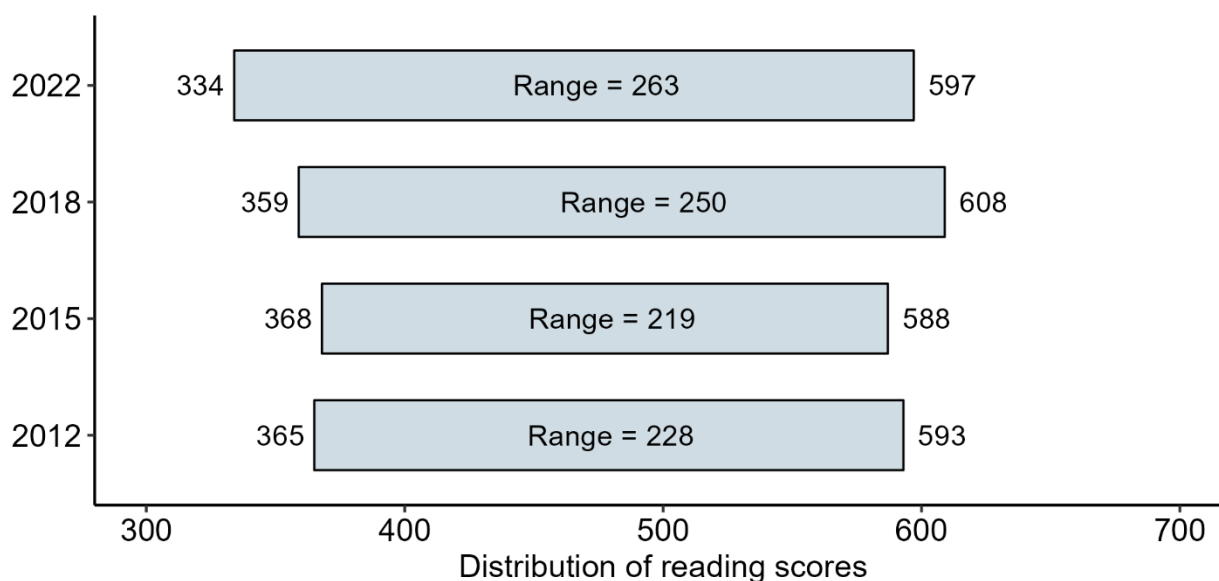
PISA Cycle	10th percentile	90th percentile	Range
2022	334	597	263
2018	359	608	250
2015	368	588	219
2012	365	593	228

Ranges calculated as 90th percentile – 10th percentile.
Ranges may appear inconsistent with percentile scores due to rounding.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Figure 4.3 and Figure 4.4 highlight this finding by focusing on reading performance at the 90th and 10th percentiles respectively, and with reference to international trends at these percentiles.

Figure 4.3 shows Wales' reading performance at the 90th percentile across the last 4 PISA cycles. Wales' reading score of 597 at the 90th percentile in PISA 2022 was not significantly different to the scores in 2018 (608), 2015 (588) and 2012 (593). The average reading score across OECD trend countries of 606 at the 90th percentile in PISA 2022 was significantly lower than the score in 2018 (614), but not significantly different to the score in 2015 (610) and in 2012 (609). Comparing learners' reading performance at the 90th percentile in Wales and across the OECD trend countries, Wales' reading score at the 90th percentile was significantly below the OECD's score in 2015 and 2012, but not significantly different to the OECD's score in 2022 and 2018.

Figure 4.3: Trends in reading performance at the 90th percentile for Wales, comparator countries and on average across OECD trend countries

Reading score (90th percentile)
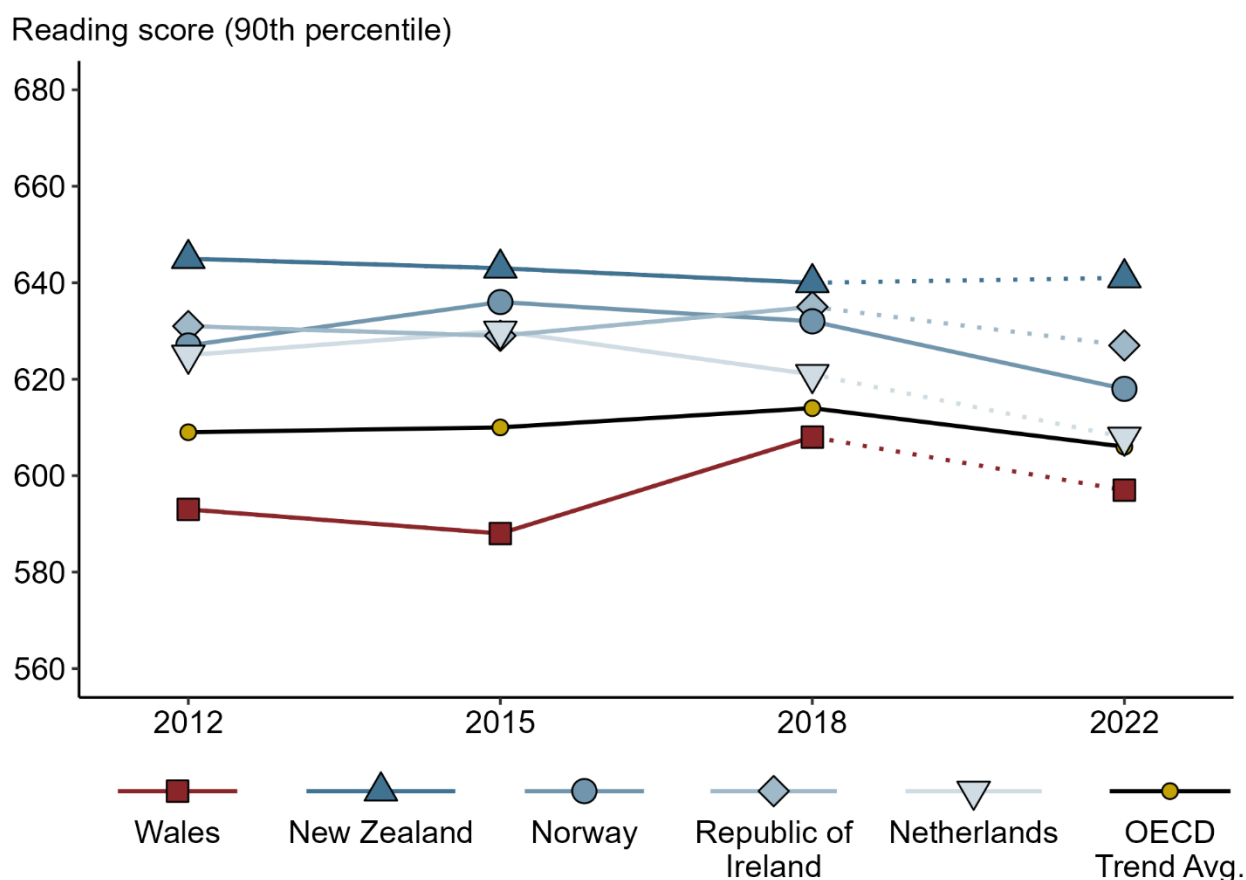
Country	2012	2015	2018	2022
Wales	593	588	608	597
Netherlands	* 625	* 630	* 621	608
New Zealand	645	643	640	641
Norway	627	* 636	* 632	618
Republic of Ireland (ROI)	631	629	635	627
OECD Trend Average	609	610	* 614	606

Asterisks (*) indicate that the score shown was significantly different to that system's score for PISA 2022. Trend results where PISA sampling standards were not all met indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Looking at the comparator countries, New Zealand and the Republic of Ireland showed relative consistency in reading performance at the 90th percentile from 2012, similar to Wales. In both countries, the reading score at the 90th percentile in PISA 2022 was not significantly different to the scores in the 3 previous PISA cycles. On the other hand, the Netherlands and Norway showed a downward trend from 2015. The Netherland's reading

score at the 90th percentile in PISA 2022 (608) was significantly lower than the score in 2018 (621), 2015 (630) and 2012 (625), and Norway's reading score at the 90th percentile in PISA 2022 (618) was significantly lower than the scores in 2018 (632) and 2015 (636), but not significantly different to the score in 2012 (627).

Figure 4.4 shows Wales' reading performance at the 10th percentile across the last 4 PISA cycles. Wales' score of 334 at the 10th percentile in PISA 2022 was significantly lower than the score in 2018 (359), 2015 (368) and 2012 (365).

On average across the OECD trend countries, there has been a downward trend in reading performance at the 10th percentile since 2012. The reading score at the 10th percentile was significantly lower in PISA 2022 (343) than in 2018 (355), 2015 (362) and 2012 (370). Comparing learners' reading performance at the 10th percentile in Wales and across the OECD countries, Wales' reading score at the 10th percentile was not significantly different to the score on average across OECD trend countries in each of the last 4 PISA cycles.

Looking at the comparator countries, the Republic of Ireland showed little change in reading performance at the 10th percentile from 2012. The reading score for the Republic of Ireland at the 10th percentile in PISA 2022 (400) was not significantly different to the scores in the 3 previous PISA cycles. On the other hand, the Netherlands and New Zealand showed a downward trend from 2012. In the Netherlands, the reading score at the 10th percentile in PISA 2022 (304) was significantly lower than the scores in 2018 (344), 2015 (368) and 2012 (386). In New Zealand, the score in PISA 2022 (354) was significantly lower than the score in 2015 (368) and 2012 (374), but not significantly different to the score in 2018 (362). Norway also showed a downward trend from 2015, with the score in PISA 2022 (323) significantly lower than the scores in 2018 (356), 2015 (381) and 2012 (375).

Figure 4.4: Trends in reading performance at the 10th percentile for Wales, comparator countries and on average across OECD countries

Reading score (10th percentile)
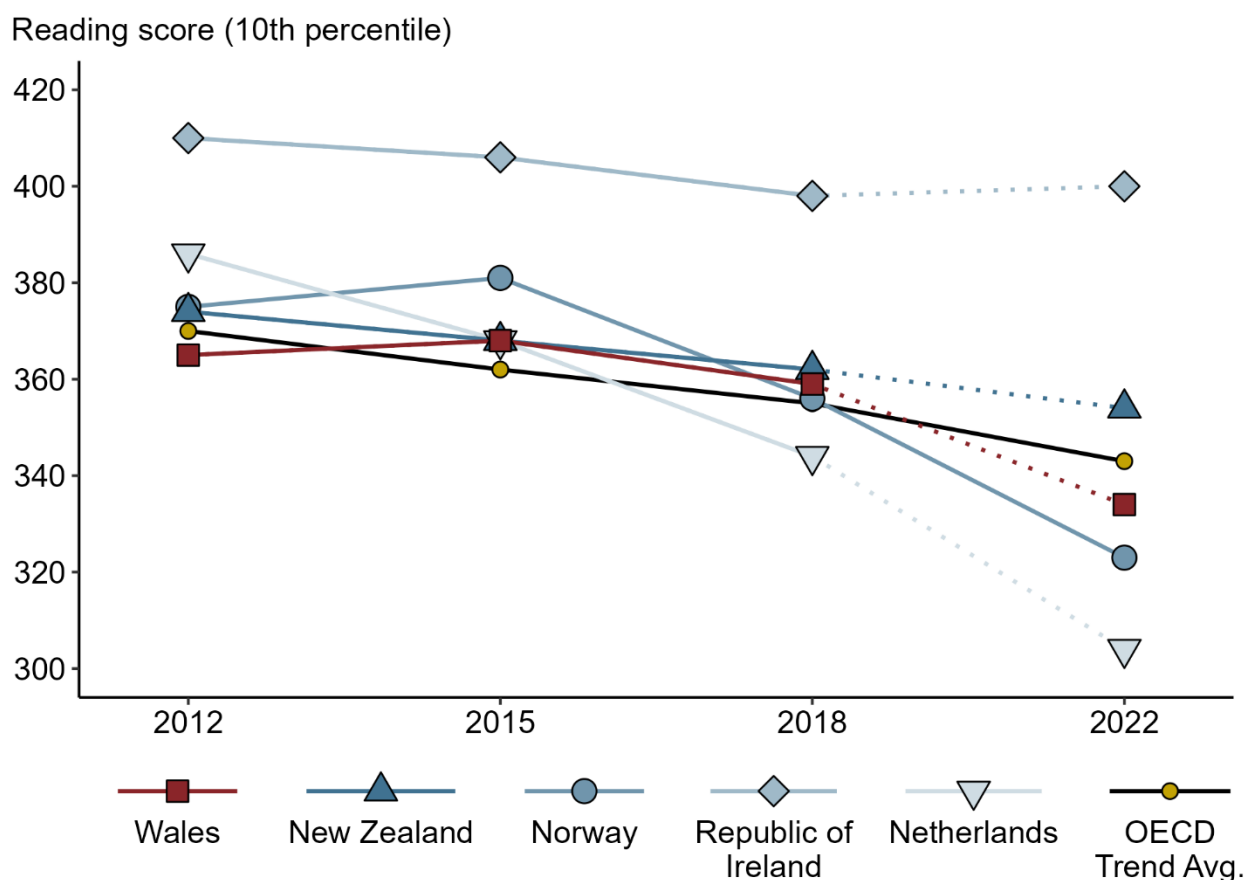
Country	2012	2015	2018	2022
Wales	* 365	* 368	* 359	334
Netherlands	* 386	* 368	* 344	304
New Zealand	* 374	* 368	362	354
Norway	* 375	* 381	* 356	323
Republic of Ireland (ROI)	410	406	398	400
OECD Trend Average	* 370	* 362	* 355	343

Asterisks (*) indicate that the score shown was significantly different to that system's score for PISA 2022. Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

4.7 Performance across reading proficiency levels

Another way of assessing the spread of reading performance across the country was to look at the proportion of learners performing at each of the PISA proficiency levels. These provide descriptors of how PISA scores in reading correspond with learners' ability

to understand, interpret, and critically evaluate texts (OECD, 2023b). Learners who score below Level 2 are considered low performers and those who perform at Level 5 or above are considered top performers. Level 2 is considered the baseline level of proficiency in reading needed for learners to participate fully in society.

Figure 4.5 provides an overview of the proportion of learners in Wales who performed at each of the proficiency levels in reading in PISA 2022, compared to the proportion of learners reaching each proficiency level on average across the OECD countries and in the comparator countries.

In PISA 2022, the proportion of learners in Wales reaching each reading proficiency level deviated from the proportion of learners across the OECD countries. Wales had a significantly lower proportion of learners who scored above the threshold for the Level 5 proficiency level, with 5% of learners in Wales performing at Level 5 or Level 6 compared to 7% on average across the OECD countries. At the other end of the distribution, the proportion of Wales' learners who scored at the lowest proficiency levels (below Level 2) (29%) was not significantly different to that on average across the OECD countries (26%).

Looking at the comparator countries, the proportion of learners scoring at the lowest proficiency levels in Wales was higher than New Zealand (21%) and the Republic of Ireland (11%), not significantly different to Norway (27%), and lower than the Netherlands (35%). At the other end of the distribution, the proportion of learners performing at proficiency levels 5 or 6 in Wales was lower than in New Zealand (13%), Norway (9%) and the Republic of Ireland (10%), but not significantly different to the Netherlands (7%).

Figure 4.5: Proportion of learners in Wales, comparator countries and on average across OECD countries performing at each PISA reading proficiency level
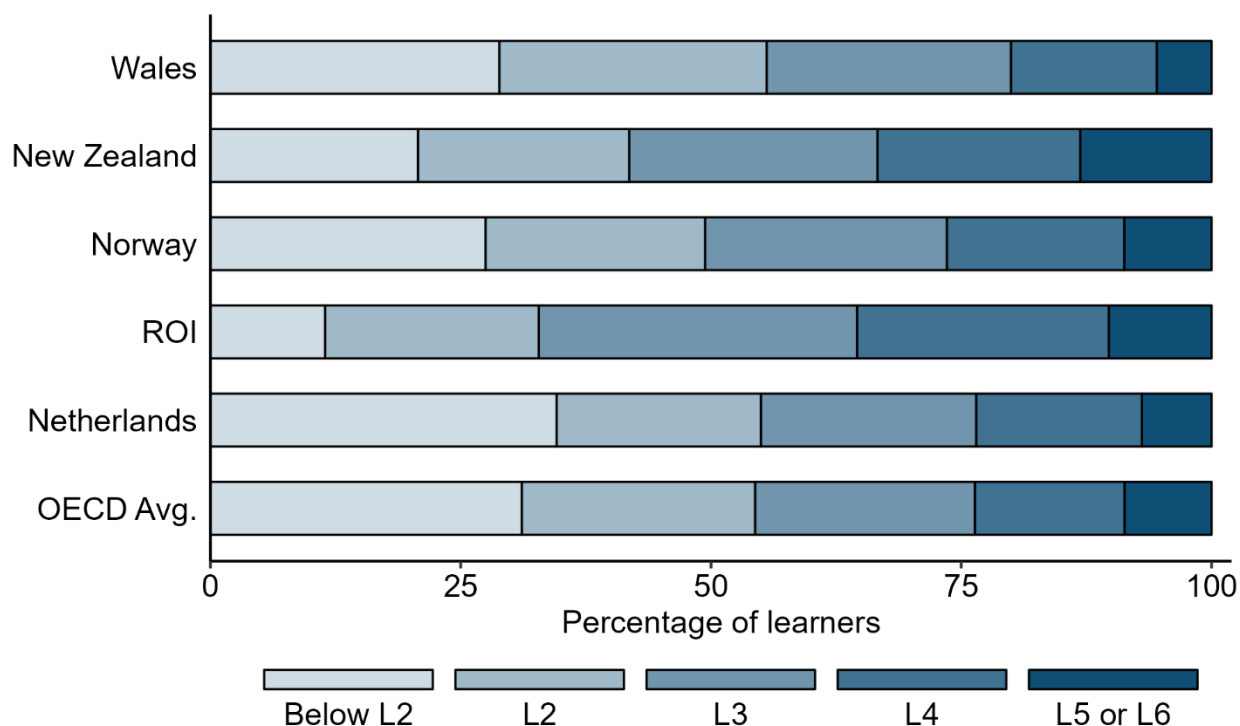
Country	Below L2	L2	L3	L4	L5 or L6
Wales	29%	27%	24%	15%	5%
Netherlands	35%	20%	22%	17%	7%
New Zealand	21%	21%	25%	20%	13%
Norway	27%	22%	24%	18%	9%
Republic of Ireland (ROI)	11%	21%	32%	25%	10%
OECD Average	26%	24%	25%	17%	7%

*Percentages may appear inconsistent due to rounding.*

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022

5 Science

5.1 Chapter overview

This chapter focuses on Wales' performance in the science domain of PISA 2022, and how this compares to the performance of other education systems and to Wales' performance in previous PISA studies. This chapter also looks at the range of learners' science performance in Wales, and the percentage of learners in Wales who perform at the different PISA proficiency levels in science. Caution needs to be taken in interpreting these findings as some of the sampling standards for PISA 2022 were not met in Wales as described in Chapter 1.

5.2 Key findings

- Wales' overall average score in science was 473. This was significantly below the OECD average of 485. Wales performed similarly to the OECD average in 2018.

- Wales' overall average score in science in 2022 was significantly higher than the scores of 43 other education systems, not significantly different to 6 systems, and significantly lower than the scores of 30 systems.

- Wales' overall average science score (473) in 2022 was significantly lower than the score of 488 achieved in 2018. On average across the OECD, there was no significant change in average science scores since 2018. Thirteen education systems with average scores above 400 saw significant improvements in their science scores over this period, whereas 14, including Wales, saw significant decreases.

- Over the 10-year period from 2012 to 2022, the performance of learners in science has declined both in Wales and on average across the OECD. Wales' overall average science score has dropped from 491 in 2012 to 473 in 2022, while the OECD trend average has dropped from 499 to 487 over the same period.

- The distribution of science scores in Wales in 2022 was wider than in 2012, 2015, and 2018. This has been due to a decline in the scores of lower achieving learners in Wales, whereas the scores of higher achieving learners in Wales have remained relatively stable over this period.

- Wales had a smaller percentage of learners that were classified as 'top performers' in science (performing at Level 5 proficiency or above) than on average across OECD countries (6% compared to 7%). Wales also had a significantly higher percentage of 'low performers' (performing below Level 2 proficiency) than on average across the OECD (27% compared to 24%).

5.3   Introduction to science in PISA

This chapter focuses on Wales' performance in the science domain of PISA, looking at how Wales' performance in 2022 compares to that of other participating education systems, as well as the range between the highest and lowest scoring learners and the percentages of learners performing at each of the PISA proficiency levels.

The framework for assessing learners' scientific literacy was revised in PISA 2015, when science was last the major domain in PISA. In the PISA science framework, three main competencies of scientific literacy are assessed:

- Explaining phenomena scientifically

- Evaluating and designing scientific enquiry

- Interpreting data and evidence scientifically

These competencies are assessed over three main content areas:

- Living systems (e.g., cells, organisms and human biology)

- Physical systems (e.g., matter, motion, and forces)

- Earth and space science systems (e.g., the history of the Earth, space, and the universe)

More information on the current PISA science framework and example science test items from previous PISA cycles can be found in the OECD PISA 2015 Science Framework. Unlike in the major domain of PISA 2022, mathematics, there are no subdomain scores for these different competency and content areas of the scientific literacy framework in PISA 2022. Instead, this chapter focuses on Wales' estimate of overall science performance, including trends over time and in relation to other education systems.

As Wales' school-level and learner-level response rates did not meet some of the PISA sampling standards, caution is required when interpreting the analysis reported here. Cautious interpretation is particularly necessary when considering trends in performance over time and when making international comparisons. The Republic of Ireland and New Zealand, which have been included as comparator countries, also did not meet some of the PISA sampling standards as well as some of the other OECD countries included in the OECD averages. For more information see Section 1.4.2.

5.4   Wales' performance in science

Wales' score in science in PISA 2022 was 473. This was significantly higher than the overall average science scores of 43 education systems that participated in PISA 2022, not significantly different to the performance of 6 other education systems, and significantly lower than the science scores of 30 education systems. Wales' overall average science score was also significantly lower than the OECD average science

score of 485. These education systems and their scores in science relative to Wales are presented in Table 5.1.

Table 5.1: Science performance of higher-performing education systems in PISA 2022 relative to Wales

Performance relative to Wales	Education system and score
Education systems that scored significantly higher than Wales in science in PISA 2022	Singapore (561), Japan (547), Macao (543), Taiwan (537), South Korea (528), Estonia (526), Hong Kong (520), Canada (515), Finland (511), Australia (507), New Zealand (504), Republic of Ireland (504), Switzerland (503), Slovenia (500), United States (499), Poland (499), Czech Republic (498), Latvia (494), Denmark (494), Sweden (494), Germany (492), Austria (491), Belgium (491), Netherlands (488), France (487), Hungary (486), Spain (485), Lithuania (484), Portugal (484), Croatia (483)
Wales and education systems that did not score significantly higher or lower than Wales in science in PISA 2022	Norway (478), Italy (477), Turkey (476), **Wales (473)**, Vietnam (472), Malta (466), Israel (465)
Education systems that scored significantly lower than Wales in science in PISA 2022	Slovakia (462), Ukrainian regions (450), Serbia (447), Iceland (447), Brunei Darussalam (446), Chile (444), Greece (441), Uruguay (435), Qatar (432), United Arab Emirates (432), Romania (428), Kazakhstan (423), Bulgaria (421), Moldova (417), Malaysia (416), Mongolia (412), Colombia (411), Costa Rica (411), Mexico (410), Thailand (409), Peru (408), Argentina (406), Montenegro (403), Brazil (403), Jamaica (403)

Base: All education systems with average scores over 400 in science in PISA 2022.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Singapore was the highest performing education system in science in PISA 2022; their score of 561 was significantly higher than the score of every other participating education system. Japan, Macao and Taiwan were the next highest-performing systems, and all significantly outperformed the highest-performing education system outside of East Asia, Estonia.

5.5 Science performance over time

Wales' science score of 473 in PISA 2022 compares to a score of 488 in PISA 2018, representing a statistically significant drop in performance. The OECD trend average in

PISA 2022 was 487, and did not significantly change from the OECD trend average of 489 in PISA 2018.

Table 2.2 shows the changes in science scores between PISA 2018 and PISA 2022 for the 58 education systems (including Wales) that participated in both PISA 2018 and PISA 2022 and scored above 400 in science in PISA 2022. Thirteen of these education systems scored significantly higher in science in PISA 2022 than in PISA 2018, with Kazakhstan, Taiwan and Japan experiencing the greatest gains. By contrast, 14 education systems, including Wales, saw their overall science score significantly drop from 2018. The remaining 31 of these education systems experienced no statistically significant changes in their science score over this period.

Table 5.2: Changes in science average score in PISA 2022 relative to performance in PISA 2018 for higher-performing education systems

Trend in science performance	Education system and change in score
Scored significantly higher in science in PISA 2022 than in PISA 2018	Kazakhstan (+26), Taiwan (+22), Japan (+17), Brunei Darussalam (+15), Qatar (+13), Singapore (+10), Croatia (+10), Uruguay (+10) Italy (+9), Malta (+9), Republic of Ireland (+8), Turkey (+8), Latvia (+7)
No statistically significant differences in science scores between PISA 2022 and PISA 2018	South Korea (+9), Serbia (+8), Switzerland (+7), Hungary (+5), Australia (+4), Hong Kong (+4), Peru (+4), Israel (+3), Lithuania (+2), Argentina (+2), Romania (+2), Austria (+1), Denmark (+1), Czech Republic (+1), Chile (+0), Macao (+0), Brazil (−1), United Arab Emirates (−2), Slovakia (−2), Colombia (−2), United States (−3), Canada (−3), Bulgaria (−3)
Scored significantly lower in science in PISA 2022 than in PISA 2018	Slovenia (−7), Mexico (−9), Greece (−11), Germany (−11), Finland (−11), Montenegro (−12), Moldova (−12), Norway (−12), Poland (−12), Netherlands (−15), **Wales (−15)**, Thailand (−17), Malaysia (−21), Iceland (−28)

Base: All education systems with average scores over 400 in science in PISA 2022 that also participated in PISA 2018.
Change in science score (2022 score – 2018 score) presented in parenthesis.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Additionally, Table 5.3 reports the changes in mean science scores since PISA 2015, the last PISA study in which science was the major domain. Of the 53 education systems that participated both in 2015 and 2022 and scored above 400 in science in PISA 2022, 9 have shown statistically significant improvements over this period, while 21 education systems, including Wales, have experienced significant drops. Most of the education systems that have experienced significant drops in performance over this period are

OECD countries in Western Europe. In the remaining 23 education systems there were no significant differences in their mean science scores in 2015 and 2022.

Table 5.3: Changes in science average score in PISA 2022 relative to performance in PISA 2015 for higher-performing education systems

Trend in science performance	Education system and change in score
Scored significantly higher in science in PISA 2022 than in PISA 2015	Turkey (+50), Macao (+15), Qatar (+15), South Korea (+12), Peru (+11), Hungary (+9), Lithuania (+9), Croatia (+7), Singapore (+6)
No statistically significant differences in science scores between PISA 2022 and PISA 2015	Japan (+8), Taiwan (+5), Czech Republic (+5), Latvia (+4), United States (+3), Brazil (+2), Slovakia (+1), Republic of Ireland (+1), Malta (+1), Sweden (+0), Uruguay (+0), Israel (−2), Poland (−2), Hong Kong (−3), Switzerland (−3), Australia (−3), Italy (−3), Uruguay (−3), Austria (−4), Colombia (−5), United Arab Emirates (−5), Mexico (−6), Romania (−7)
Scored significantly lower in science in PISA 2022 than in PISA 2015	Montenegro (−8), France (−8), Denmark (−8), Spain (−8), Estonia (−8), Costa Rica (−9), New Zealand (−9), Moldova (−11), **Wales (−11)**, Thailand (−12), Slovenia (−13), Canada (−13), Greece (−14), Portugal (−17), Belgium (−11), Germany (−17), Norway (−20), Netherlands (−20), Finland (−20), Bulgaria (−25), Iceland (−26)

Base: All education systems with average scores over 400 in science in PISA 2022 that also participated in PISA 2015.
Change in science score (2022 score – 2015 score) presented in parenthesis.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Figure 5.1 presents Wales' overall performance in science over the last 4 cycles of PISA relative to the comparator countries and to the OECD trend average. As reported in Section 1.4.3, these comparator countries are New Zealand, Norway, the Republic of Ireland, and specifically for science, Italy.

Figure 5.1: Trends in science performance in Wales, comparator countries, and on average across OECD trend countries

Overall average science score
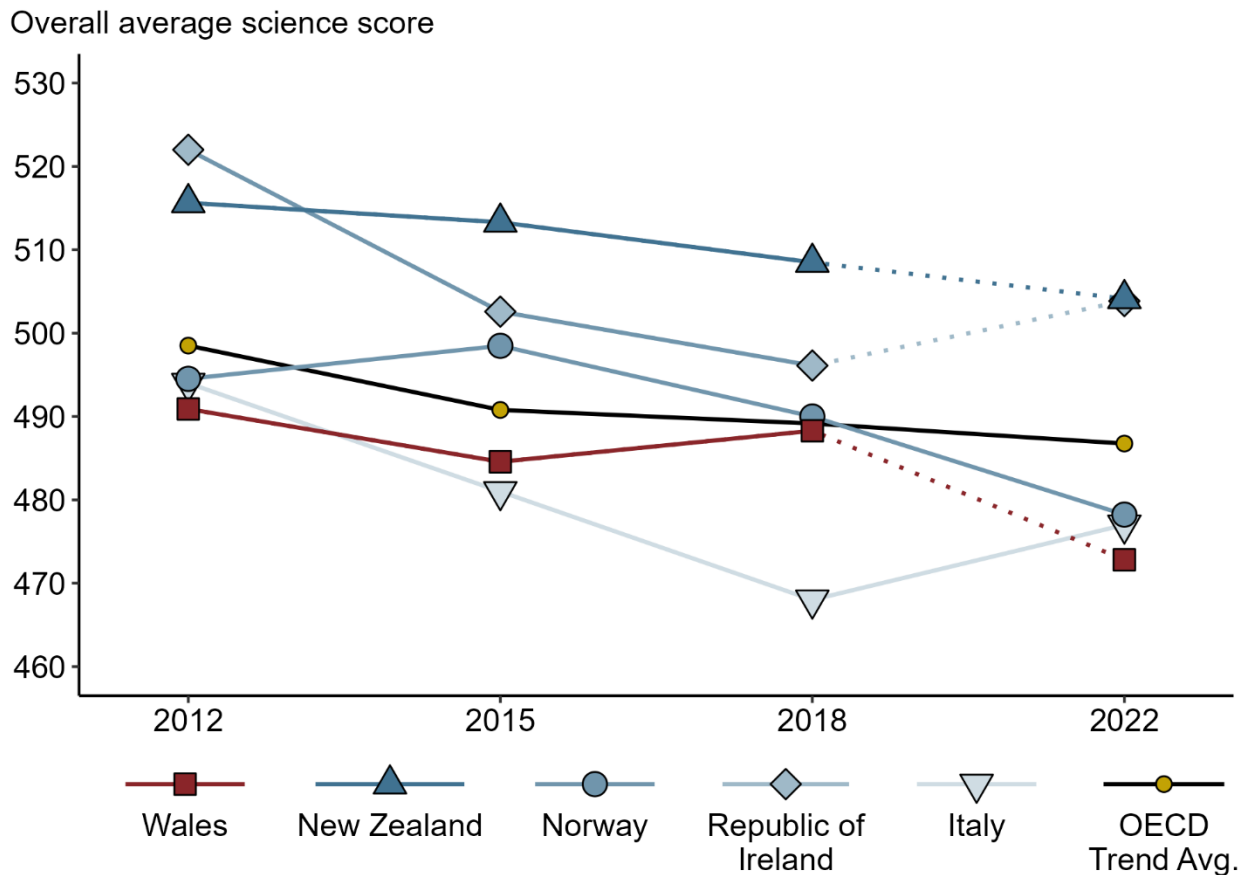
Country	2012	2015	2018	2022
Wales	* 491	* 485	* 488	473
New Zealand	516	* 513	508	504
Norway	* 495	* 498	* 490	478
Republic of Ireland (ROI)	* 522	503	* 496	504
Italy	* 494	481	* 468	477
OECD Trend Average	* 499	* 491	489	487

Asterisks (*) indicate that the score shown was significantly different to that country's score for PISA 2022. Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Wales' science score of 473 in PISA 2022 was significantly lower than the scores in 2012 (491), 2015 (485) and 2018 (488). The OECD trend average score of 487 in PISA 2022 was also significantly lower than the OECD average scores in 2015 and 2012. While Wales scored similarly to the OECD trend average in science in PISA 2018, Wales' score in 2022 was significantly below this average.

Looking across the comparator countries, all 4 countries have experienced some form of statistically significant drop in performance since 2012; while New Zealand's score of 504 in PISA 2022 represents a significant drop from the score of 513 in PISA 2015, Norway's score of 478 was significantly lower than their scores in 2012, 2015 and 2018, and for the first time, is significantly lower than the OECD average. Both the Republic of Ireland's and Italy's science scores (504 and 477 respectively) represent statistically significant improvements from their scores in PISA 2018, but they also remain significantly lower than their score of 522 and 494 back in PISA 2012. New Zealand and the Republic of Ireland, have continued to score significantly above the OECD trend average, as they had done in all previous cycles, whereas Italy and Norway both performed significantly below the average.

5.6   Differences between the highest- and lowest-performing learners in science

In this section, we look at the range of learners' achievement in science by discussing Wales' scores at the 90th and 10th percentiles. The 90th percentile is the score above which the highest-achieving 10% of learners obtain, while the 10th percentile is the score below which the lowest-achieving 10% of learners obtain. The difference between the highest- and lowest-achieving learners at the 90th and 10th percentiles is a better measure of the spread of scores for comparing countries than using the very highest- and lowest-achieving learners, as the latter comparison may be affected by a small number of learners with unusually high or low scores.

Figure 5.2 summarises Wales' scores in science at the 90th and 10th percentiles across the past 4 cycles of PISA, and reports the range between these percentiles (calculated as the 90th percentile score minus the 10th percentile score). Compared to the ranges between the 90th and 10th percentiles in the past three PISA studies, there has been a significant increase in the range of scores in Wales; this has been driven by a significant lowering of scores at the 10th percentile, rather than significant changes in the score at the 90th percentile.

Figure 5.2: Trends in the gap in science performance in Wales
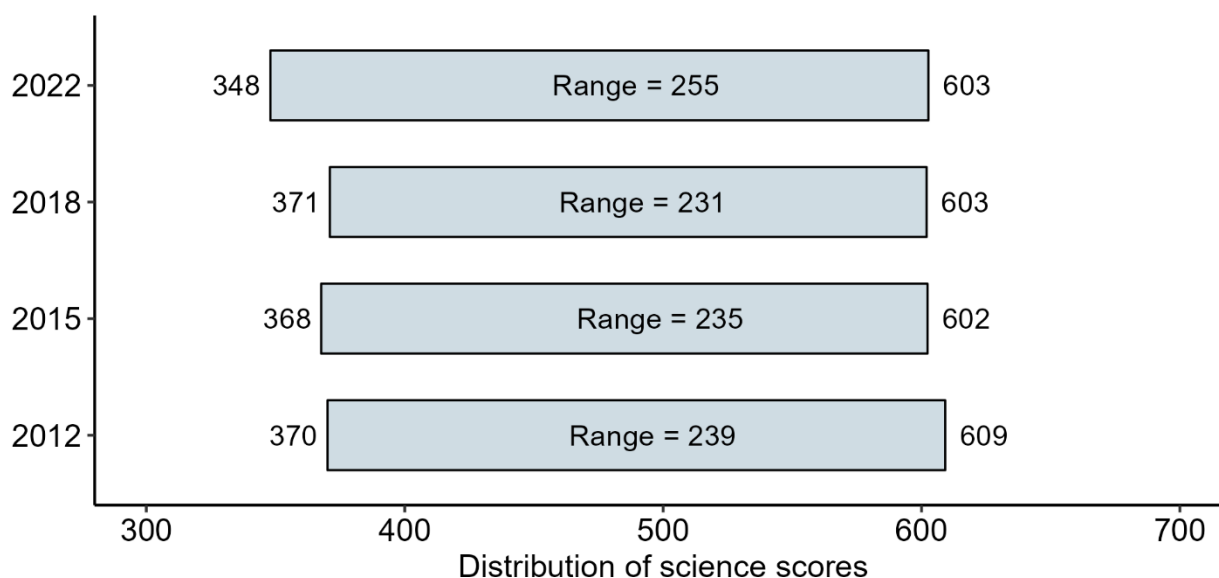
PISA cycle	10th percentile	90th percentile	Range
2022	348	603	255
2018	371	603	231
2015	368	602	235
2012	370	609	239

Ranges calculated as 90th percentile – 10th percentile. Ranges may appear inconsistent with percentile scores due to rounding.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Figure 5.3 and Figure 5.4 focus on science scores at the 90th and 10th percentiles respectively, and with reference trends in the comparator countries and on average across the OECD trend countries at these percentiles.

There have been no statistically significant changes in Wales' score at the 90th percentile since 2012, but Wales' score at the 10th percentile was significantly lower than in all 3 of the last PISA studies. This is also the case with the OECD trend average at these percentiles, suggesting that the international pattern of lower overall average science scores is being primarily driven by a significant decline in the scores of lower achieving learners.

Figure 5.3: Trends in science achievement at the 90th percentile for Wales, comparator countries and on average across OECD trend countries
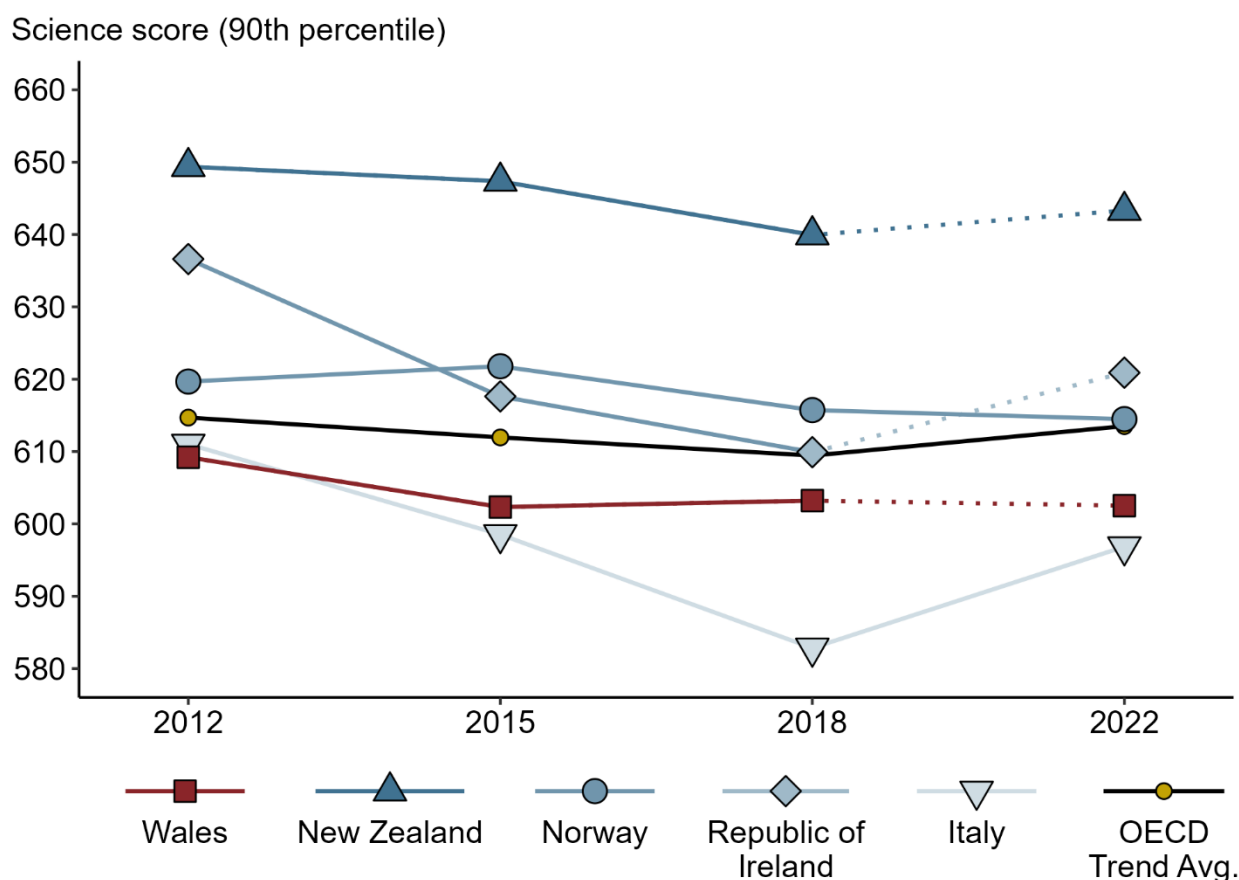
Country	2012	2015	2018	2022
Wales	609	602	603	603
New Zealand	649	647	640	643
Norway	620	622	616	614
Republic of Ireland (ROI)	* 637	618	* 610	621
Italy	* 611	599	* 583	597
OECD Trend Average	615	612	609	614

Asterisks (*) indicate that the score shown was significantly different to that country's score for PISA 2022. Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Figure 5.4: Trends in science achievement at the 10th percentile for Wales, comparator countries and on average across OECD trend countries
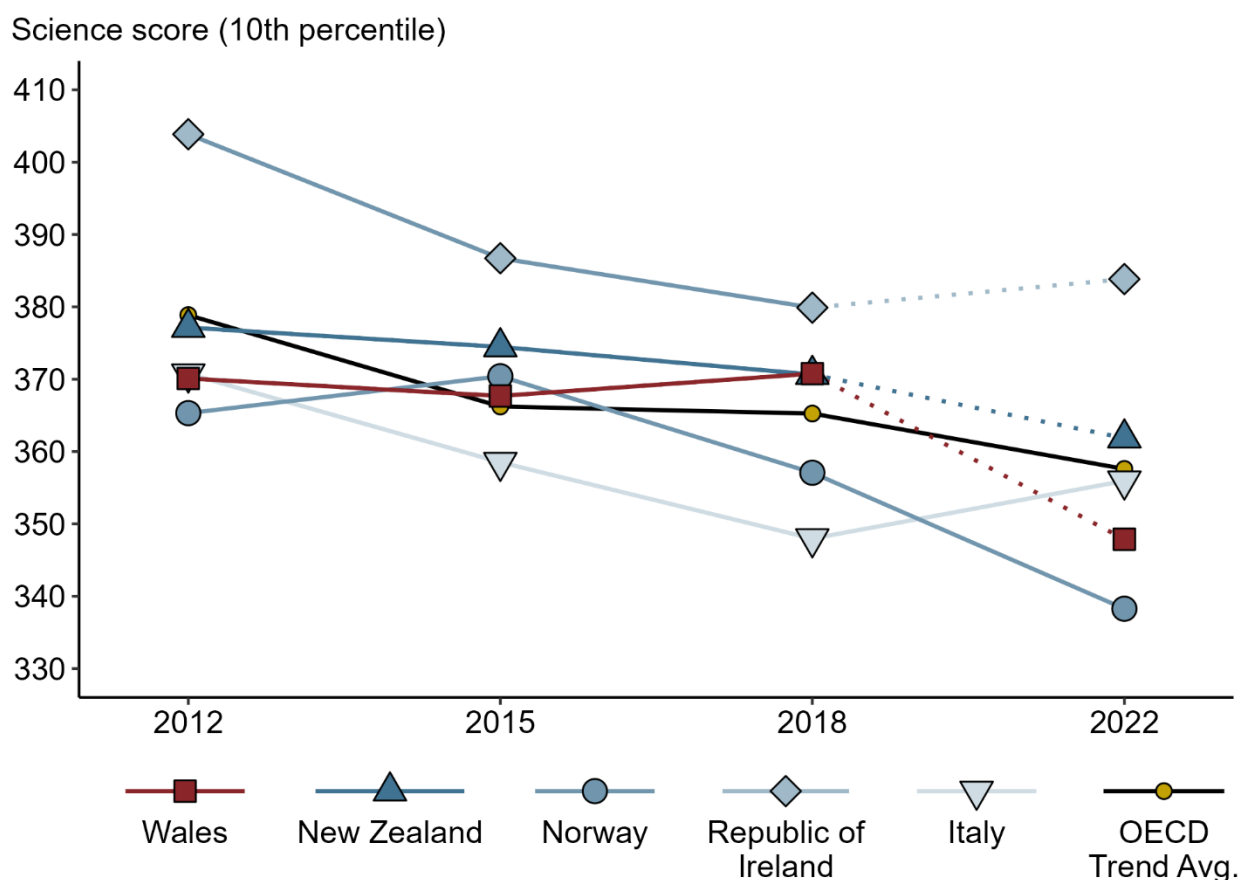
Country	2012	2015	2018	2022
Wales	* 370	* 368	* 371	348
New Zealand	377	* 374	371	362
Norway	* 365	* 370	* 357	338
Republic of Ireland (ROI)	* 404	387	380	384
Italy	* 371	359	348	356
OECD Trend Average	* 379	* 366	* 365	358

Asterisks (*) indicate that the score shown was significantly different to that country's score for PISA 2022. Trend results where PISA sampling standards were not all met are indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

New Zealand's score at the 10th percentile in 2022 was significantly lower than in 2015 – while the raw estimate of New Zealand's score in 2012 was a higher number than in 2015, greater statistical error associated with New Zealand's 2012 data alongside greater statistical error associated with drawing comparisons to data from 2012 mean that the

comparison between the 2012 and 2022 estimates at the 10th percentile are not statistically significant. There have been no statistically significant changes in New Zealand's score at the 90th percentile since 2012.

Norway has experienced no significant changes in performance at the 90th percentile since 2012, but scored significantly lower at the 10th percentile in 2022 than in all 3 of their previous participations. Norway's score at the 90th percentile is similar to the OECD trend average, but significantly lower than the OECD trend average at the 10th percentile.

The Republic of Ireland and Italy have both maintained a stable range of science achievement between the 10th and 90th percentiles between 2012 and 2022, with no significant difference in the sizes of these ranges. However, their individual scores at both the 10th and 90th percentiles are significantly lower than their scores at these percentiles in 2012, while significantly higher than in 2018 at the 90th percentile.

5.7 Performance across science proficiency levels

Another way of assessing the spread of performance across the country is to look at the percentage of learners performing at each of the PISA proficiency levels. These provide descriptors of how PISA scores in science correspond with learners' skills, knowledge and proficiencies. The OECD defines low performers in science as those who score below the Level 2 threshold[9], and top performers as those scoring at or above Level 5[10]. As in the case of mathematics and reading, Level 2 is defined as the benchmark at which learners begin to demonstrate the skills necessary for full participation in society, and being able to engage in reasoned discourse about science and technology. Learners performing at Level 5 meanwhile are able to apply their wide skill and knowledge about science to answering a broad range of questions across many different contexts, and evaluate the limitations of different sources of scientific information (OECD, 2023b).

Figure 5.5 provides an overview of the percentage of learners in Wales who performed at each of the proficiency levels in science in PISA 2022, compared to the percentage of learners reaching each proficiency level across the OECD.

---

[9] Level 2 threshold score in science = 409.54
[10] Level 5 threshold score in science = 633.33

Figure 5.5: Percentage of learners in Wales, comparator countries and on average across OECD countries performing at each PISA science proficiency level
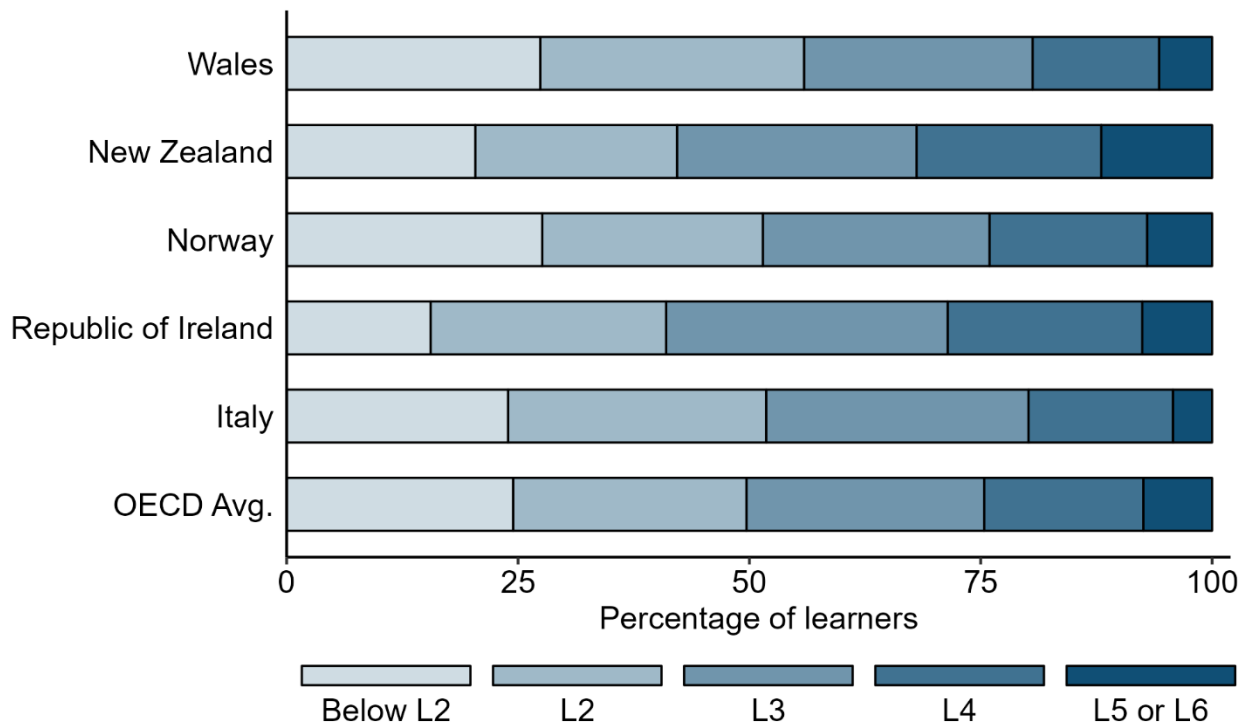
Country	Below L2	L2	L3	L4	L5 or L6
Wales	27%	28%	25%	14%	6%
New Zealand	20%	22%	26%	20%	12%
Norway	28%	24%	25%	17%	7%
Republic of Ireland (ROI)	16%	25%	30%	21%	8%
Italy	24%	28%	28%	16%	4%
OECD Average	24%	25%	26%	17%	7%

Percentages may appear inconsistent due to rounding.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Approximately 6% of learners in Wales scored at or above Level 5. This was significantly below the OECD average (7%), but similar to Norway[11] and Italy. Additionally, a greater percentage of learners in Wales, 27%, performed below Level 2 (at Level 1a or Level 1b) than across the OECD, though this was also similar to the percentage of learners in Norway. The Republic of Ireland had the lowest percentage of low performers, while New Zealand had a significantly higher percentage of top performers than the other comparators.

---

[11] Statistical significance depends on the standard error of the estimate, as well as the difference in the values. The standard error associated with the OECD average is relatively small.

6 Performance by learner characteristics

6.1 Chapter overview

In this chapter we explore differences in learners' PISA scores in mathematics according to specific characteristics: gender, socioeconomic status, immigrant status and additional learning needs.

Caution needs to be taken in interpreting these findings as some of the sampling standards for PISA 2022 were not met in Wales as described in Chapter 1. We are able to draw somewhat stronger conclusions when comparing across some groups of learners within Wales as described in Chapter 1. The non-response bias analysis showed no relationship between the gender of learners or free school meal eligibility and their likelihood of participating in PISA, for example. We can therefore draw stronger conclusions when comparing the performance of girls and boys or learners with different socioeconomic backgrounds within Wales.

6.2 Key findings

- In mathematics boys performed significantly higher than girls by 9 score points. In 2018 there was no significant difference in the boys' and girls' performance in mathematics. In 2015 and 2012 boys performed significantly higher that girls with a similar score point difference to that in 2022.

- On average across OECD countries boys performed significantly higher than girls by 9 score points. In the majority of high-performing education systems[12] boys performed significantly higher than girls in mathematics.

- In Wales, the score at the 10th percentile for girls (359) was significantly higher than the score at the 10th percentile for boys (344). The mathematics score at the 90th percentile for girls was 568 compared to a score of 597 for boys. This was not significantly different from the average across OECD countries where there was a 22 score point difference (after rounding) between boys (600) and girls (579) at the 90th percentile.

- At the highest proficiency levels (Levels 5 & 6), there were significantly more boys (8%) than girls (5%) performing at these levels. In contrast, there was no significant difference between the percentage of boys (31%) and the percentage of girls (32%) performing below the baseline proficiency level (Level 2). Boys had a significantly higher average score than girls in the quantity and space and shape mathematics content subdomains and in the mathematical reasoning, formulating and employing subdomains. There were no significant differences between the

---

[12] Those education systems with an average mathematics score of over 400 score points.

performance of boys and girls in the change and relationships and uncertainty and data content subdomains or in the interpreting process subdomain.

- In reading, girls performed significantly higher than boys by 19 score points. The average score for girls was 475 and for boys it was 456. The gender difference in reading average scores for Wales was not significantly different to that of the OECD average.

- The gender difference in reading in PISA 2022 was not significantly different from the gender difference in 2018, 2015 and 2012.

- In science, the average performance of girls and boys were not significantly different. Girls in Wales had an average score of 469 compared to an average of 477 for boys. This was a 7 score point difference[13].

- Wales' average score on the ESCS Index was +0.07 indicating that on average, learners in Wales had a higher − status than the average across OECD countries (0).

- The difference in mathematics performance associated with a one-unit increase in ESCS was significantly smaller in Wales (33 score points) than on average across OECD countries (39 score points). The difference in reading performance was 28 score points in Wales and the difference in science performance was 35 score points. On average across OECD countries these scores were 39 score points for reading and 41 score points for science.

- There was a 76 score point difference in mathematics between the most disadvantaged group of learners and the least disadvantaged group of learners in Wales. In reading this difference was 65 score points and in science it was 81 score points.

- The percentage of the variance in mathematics performance in Wales that could be explained by socioeconomic status was 10%, while in reading it was 6% and in science it was 9%. On average across OECD countries 15% of the variance in mathematics performance, 13% of the variance in reading performance and 14% of the variance in science performance could be explained by socioeconomic status.

- A learner is classified as being academically resilient if they are relatively disadvantaged in terms of their socioeconomic background (they are in the bottom quarter of the ESCS Index in the country of assessment) but perform in the top quarter of learners in that country. In Wales 13% of learners were academically resilient in mathematics, 17% were academically resilient in reading and 14% were academically resilient in science. On average across OECD countries 10% of learners were academically resilient in mathematics while 11% were academically resilient in reading and science.

---

[13] After taking into account the rounding of figures

- There were no significant differences in the average mathematics, reading or science performance of learners who spoke a language other than English or Welsh at home (458, 460 and 465 respectively) and learners who spoke English or Welsh at home (468, 469 and 475 respectively).

- On average learners in Wales who were eligible for free school meals scored significantly lower in mathematics, reading and science than learners who were not eligible.

6.3 Gender

In Wales, boys performed significantly higher than girls in mathematics by 9 score points. Boys achieved an average score of 470 while girls achieved an average score of 461. This was a larger difference than in 2018, where there was a 2 score point difference, but was similar to the 10 score point gap in 2015 and the 9 score point gap in 2012. Boys in Wales have consistently achieved higher average mathematics scores than girls since 2006.

On average across OECD countries boys performed significantly higher than girls by 9 score points, with an average score of 477 for boys and 468 for girls. The gap in Wales between boys' performance in mathematics and girls' performance was the same as the average across OECD countries.

Figure 6.1: Average mathematics scores of girls and boys across higher performing education systems

Girls' average mathematics score

Boys' average mathematics score

Wales (boys sig. higher) — Girls sig. higher — No sig. difference — Boys sig. higher

Type of gender gap	Education system and gender gap size
Education systems in which girls scored significantly higher than boys in mathematics (represented by yellow squares)	Brunei Darussalam (+11), Malaysia (+10), Qatar (+8), United Arab Emirates (+7), Mongolia (+6), Finland (+5)
Education systems in which boys scored significantly higher than girls in mathematics (represented by blue diamonds)	Italy (−21), Austria (−19), Chile (−16), Macao (−15), Hungary (−15), United States (−13), Republic of Ireland (−13), Canada (−12), Singapore (−12), Denmark (−11), Germany (−11), Australia (−11), Israel (−11), Uruguay (−11), Serbia (−11), Switzerland (−11), Netherlands (−11), New Zealand (−10), Vietnam (−10), Spain (−10), Ukrainian regions (−10), France (−10), Latvia (−10), Japan (−9), Hong Kong (−9), Czech Republic (−7), Estonia (−6), Lithuania (−5)
Education systems without statistically significant gender gaps in mathematics (represented by grey circles)	Belgium (−8), Croatia (−6), Greece (−6), Turkey (−6), Taiwan (−6), Poland (−6), South Korea (−5), Romania (−5), Moldova (−4), Iceland (−3), Sweden (−2), Malta (−1), Slovakia (−1), Kazakhstan (0), Montenegro (0), Norway (+1), Slovenia (+2), Bulgaria (6)

Base: All education systems with average scores over 400 in mathematics in PISA 2022.
Gender gaps calculated as girls' mathematics score – boys' mathematics score and reported in parenthesis.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Boys performed significantly higher than girls in the majority of higher-performing education systems (those with average mathematics scores over 400 score points) as shown in Figure 6.1. The diagonal line on the figure shows the point where girls' and boys' scores were not significantly different. Education systems in which girls scored significantly higher than boys in mathematics are shown in yellow above the line, while systems where boys scored significantly higher than girls are shown in blue below the line. Girls scored significantly higher than boys in just 6 of the higher-performing education systems. In 18 higher-performing education systems there were no significant differences between the average score in mathematics for girls and boys, and in 28 higher-performing education systems boys outperformed girls.

As Figure 6.2 shows, the gender gap in Wales has been relatively stable since 2012 with the exception of 2018 and has also been consistently similar to the OECD average gap. It was also similar to the pattern of performance in New Zealand, the Republic of Ireland and Croatia where boys have scored significantly higher than girls except for in 2018 in the Republic of Ireland and in 2022 in Croatia. The performance of boys and girls on average in Norway was not statistically different and in 2018 it was one of the few education systems with a gender gap that favoured girls in mathematics.

Figure 6.2: Gender differences in mathematics scores in Wales, comparator countries and on average across OECD trend countries
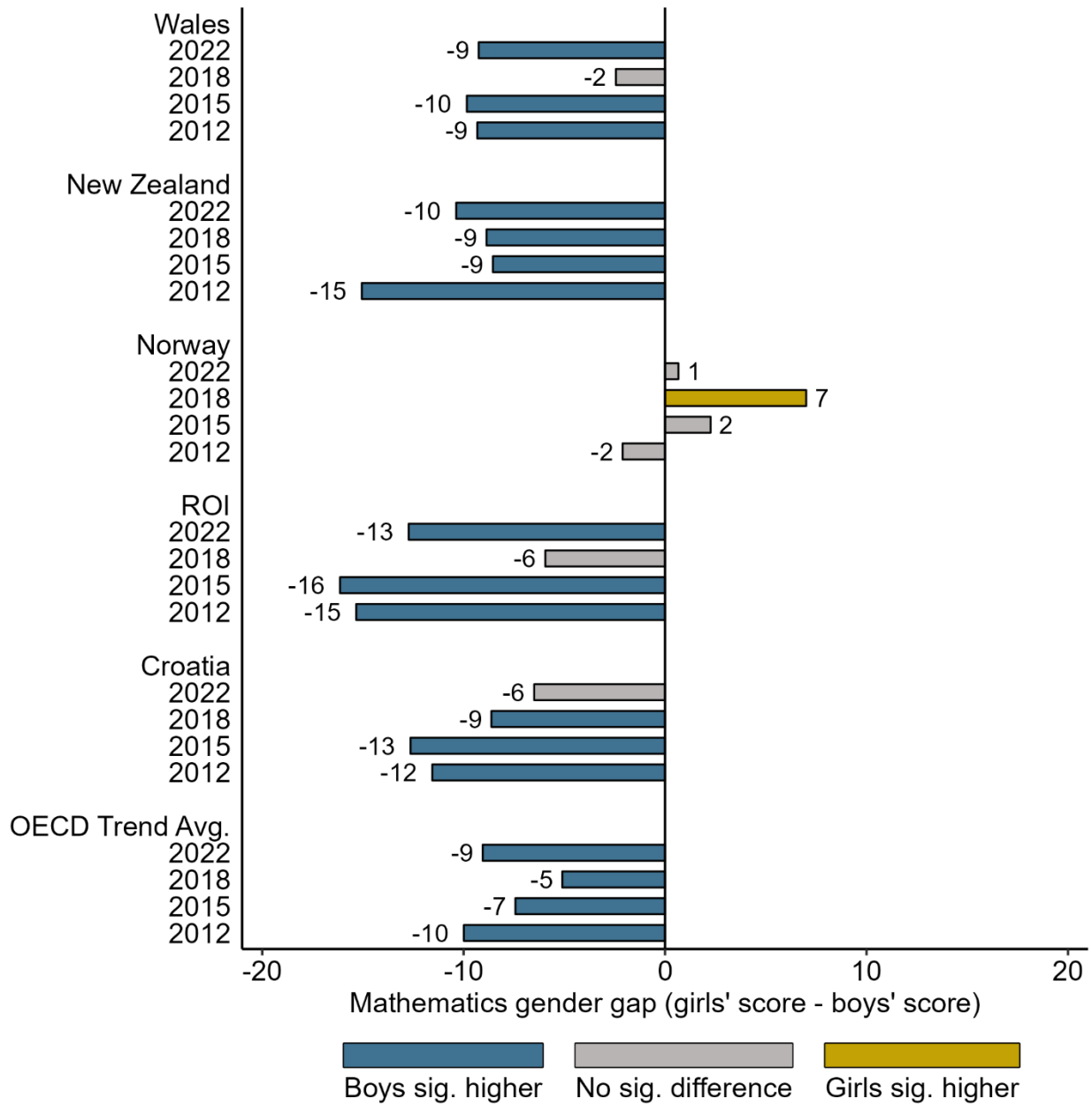
Country	2012	2015	2018	2022
Wales	* −9	* −10	−2	* −9
New Zealand	* −15	* −9	* −9	* −10
Norway	−2	2	* 7	1
Republic of Ireland	* −15	* −16	−6	* −13
Croatia	* −12	* −13	* −9	−6
OECD Trend Average	* −10	* −7	* −5	* −9

Gender gaps calculated as girls' mathematics score – boys' mathematics score.
OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.
Asterisks (*) in the table indicate that the gender gap shown represents a statistically significant difference. Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

<div align="right">Source: OECD, PISA 2022</div>

6.3.1 Gender differences among the highest- and lowest-performing learners

There are two ways to look at the differences between the highest- and lowest-performing learners. One way is to look at the score for the 90th percentile, which is the score above which the highest 10% of learners within Wales perform, and the score at the 10th percentile, which is the score below which the lowest 10% of learners within Wales perform. Another way is to look at performance at the PISA proficiency levels, specifically the percentage of learners in Wales performing at the highest levels, Levels 5 and 6, and the percentage of learners performing below the baseline threshold of Level 2. In this section, we consider both of these in relation to the differences between girls' and boys' performance.

In Wales, the score at the 10th percentile for girls (359) was significantly higher than the score at the 10th percentile for boys (344). This was a difference of 15 score points. The gender gap was largest at the 90th percentile with a difference of 28 score points (taking into account the rounding of these figures). The mathematics score at the 90th percentile for girls was 568 compared to a score of 597 for boys. This was not significantly different from the average across OECD countries where there was a 22 score point difference (after rounding) between boys (600) and girls (579) at the 90th percentile. It was also not significantly different from the average score at the 10th percentile across OECD countries where girls scored 357 points and boys scored 353 points, with a gap of 4 score points. The distribution of girls' and boys' performance in mathematics in Wales is shown in Figure 6.3

Figure 6.3 Performance of girls and boys in Wales at the 90th and 10th percentiles in mathematics
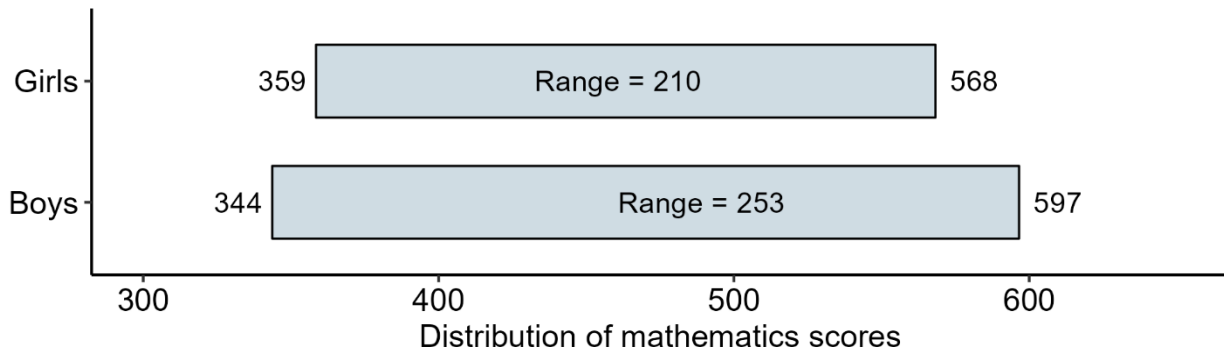
Gender	10th percentile	90th percentile	Range
Girls	359	568	210
Boys	344	597	253

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.
Some results may appear inconsistent due to rounding.

Source: OECD, PISA 2022

At the 90th percentile, the gender gap in New Zealand was 29 score points, 25 score points in the Republic of Ireland, 19 score points in Croatia and 17 score points in Norway with boys having a higher score than girls. At the 10% percentile, the gender gap was 19 score points in Norway, 8 score points in New Zealand, 5 score points in Croatia, and in the Republic of Ireland it was 2 score points with girls having a higher score than boys.

At the highest proficiency levels (Levels 5 & 6), there were significantly more boys (8%) than girls (5%) performing at these levels. In contrast, there was no significant difference between the percentage of boys (31%) and the percentage of girls (32%) performing below the baseline proficiency level (Level 2). The difference in the percentages of girls and boys at the highest proficiency levels was not significantly different from the difference on average across OECD countries where significantly fewer girls (7%) than boys (11%) achieved the highest proficiency levels. Similarly, the difference in the percentages of girls and boys performing below the baseline proficiency level was also not significantly different from the difference on average across OECD countries where 32% of girls and 31% of boys performed below the baseline proficiency level.

In Croatia, Norway, the Republic of Ireland, and New Zealand there were also significantly more boys (7%, 8%, 10%, and 13% respectively) than girls (4%, 5%, 5%, and 8% respectively) performing at the highest proficiency levels. There was no significant difference between the percentage of girls and the percentage of boys performing below the baseline proficiency level in Croatia (33% and 33% respectively), the Republic of Ireland (20% and 19% respectively), and New Zealand (28% and 29%

respectively). However, a significantly larger percentage of boys (33%) in Norway performed below the baseline level than girls (30%).

6.3.2 Mathematics Subdomains

Boys had a higher average score than girls across all of the process and content subscales, as shown in Table 6.1. The smallest difference of 3 score points was in the interpreting category and the largest difference of 16 score points was in the space and shape category. The difference between the average score for boys and the average score for girls was statistically significant except for the change and relationships, uncertainty and data, and interpreting categories.

Table 6.1: Average mathematics scores of girls and boys

Scale	Average score girls	Average score boys	Score difference
Mathematics overall	461	470	* −9
Change and relationships	461	470	−8
Quantity	457	468	* −11
Space and shape	443	459	* −16
Uncertainty and data	471	480	−9
Employing	458	470	* −12
Formulating	454	468	* −14
Interpreting	465	468	−3
Mathematical reasoning	462	471	* −9

Base: All learners
Some results may appear inconsistent due to rounding.
Score difference calculated as average girls' score – average boys' score.
Asterisks (*) in the table indicate that the gender gap shown represents a statistically significant difference
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022

On average across OECD countries there was a significant difference between the performance of girls and the performance of boys in each of the subdomains. For the content subdomains, the gender gaps were 12 score points in space and shape, 11 score points in quantity, 8 score points in change and relationships and 7 score points in uncertainty and data. For the process subdomains, the gender gaps were 15 score points in formulating, 10 score points in employing, 9 score points in mathematical reasoning and 5 score points in interpreting.

Table 6.2: Average mathematics scores of girls and boys on average across OECD countries

Scale	Average score girls	Average score boys	Score difference
Mathematics overall	468	477	* −9
Change and relationships	466	474	* −8
Quantity	467	478	* −11
Space and shape	464	477	* −12
Uncertainty and data	470	477	* −7
Formulating	461	476	* −15
Employing	467	477	* −10
Interpreting	472	477	* −5
Mathematical reasoning	468	477	* −9

Base: All learners
Some results may appear inconsistent due to rounding.
Score difference calculated as average girls' score – average boys score
Asterisks (*) in the table indicate that the gender gap shown represents a statistically significant difference
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022

6.3.3 Reading

In PISA 2022, girls in Wales had an average score for reading of 475, compared to an average score of 456 for boys. This 19 score point difference represents a statistically significant difference in performance. Looking at the OECD average, girls (488) also scored significantly higher than boys (464). The gender difference in reading score for Wales was not significantly different to that of the OECD average.

Figure 6.4 shows the reading performance of girls and boys in every participating education system with an average reading score above 400 in PISA 2022. The diagonal line on the figure shows the point where girls and boys scored equally well. Education systems in which girls scored significantly higher than boys in reading are shown in yellow above the line, while systems in which girls scored neither significantly higher nor lower than boys are shown in grey around the line. Out of 81 education systems that participated in PISA 2022 for reading including Wales, in 78 education systems girls scored significantly higher than boys. There were no systems in which boys scored significantly higher than girls. While girls also scored higher in reading than boys in Costa Rica (+3) and Chile (+7), the differences were not statistically significant.

Figure 6.4: Reading performance of girls and boys in PISA 2022

Girls' average reading score

Boys' average reading score

■	■	●	◆
Wales (girls sig. higher)	Girls sig. higher	No sig. difference	Boys sig. higher

Type of gender gap	Education system and gender gap size
Education systems in which girls scored significantly higher than boys in reading – represented by yellow squares	Finland (+45), United Arab Emirates (+45), Slovenia (+44), Norway (+42), Qatar (+40), Malta (+39), Sweden (+37), Montenegro (+36), Iceland (+35), Jamaica (+35), South Korea (+34), Brunei Darussalam (+34), Croatia (+34), Bulgaria (+33), Lithuania (+31), Moldova (+30), Slovakia (+30), Czech Republic (+29), Poland (+29), Latvia (+28), Belgium (+28), Taiwan (+27), Estonia (+27), Romania (+26), Netherlands (+26), New Zealand (+26), Serbia (+26), Greece (+25), Spain (+25), Turkey (+25), Canada (+24), Switzerland (+24), Israel (+23), Hong Kong (+23), United States (+22), Australia (+22), Portugal (+21), Denmark (+21), Austria (+20), France (+20), Singapore (+20), Germany (+19), Italy (+19), Wales (+19), Republic of Ireland (+18), Vietnam (+18), Brazil (+17), Hungary (+17), Japan (+17), Uruguay (+15), Macao (+14), Argentina (+14), Colombia (+12), Peru (+8), Mexico (+8)
Education systems without significantly significant gender gaps in reading – represented by grey circles	Chile (+7), Costa Rica (+3)
Education systems in which boys scored significantly higher than girls in reading	No higher-performing educational systems

*Base: All education systems with mean scores over 400 in reading in PISA 2022.*
Gender gaps calculated as girls' reading score – boys' reading score and reported in parenthesis.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Figure 6.5 shows the trends in the gender gaps in Wales and the comparator countries since the 2012 cycle of PISA. The gender difference in reading score for Wales in PISA 2022 (+19) was not significantly different to the gender difference in 2018 (+26), 2015 (+11) and 2012 (+27). Likewise, the gender difference in OECD's reading scores in PISA 2022 (+25) was not significantly different to the difference in 2018 (+30), 2015 (+27) and 2012 (+39).

Wales' gender difference in reading score in PISA 2022 was significantly lower than that of Norway (+42), but not significantly different to that of the Netherlands (+26), New Zealand (+26) and the Republic of Ireland (+18). Among the comparator countries, the gender differences in reading scores were lower in PISA 2022 than in 2018 and 2012, but the decreases were not statistically significant.

Figure 6.5: Trends in gender gaps in reading performance in Wales, comparator countries and on average across OECD trend countries

Boys sig. higher   No sig. difference   Girls sig. higher
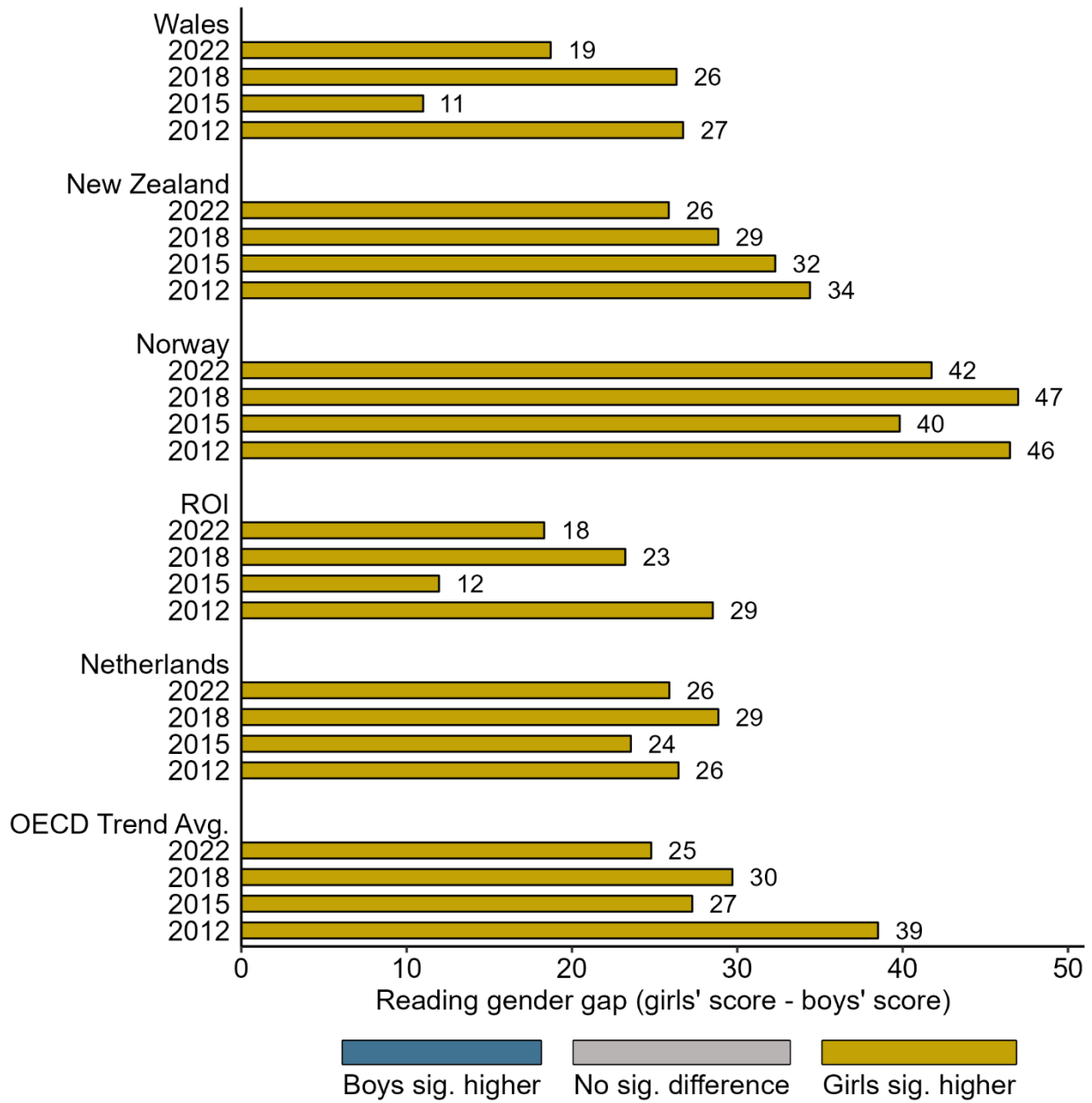
Country	2012	2015	2018	2022
Wales	* 27	* 11	* 26	* 19
Netherlands	* 26	* 24	* 29	* 26
New Zealand	* 34	* 32	* 29	* 26
Norway	* 46	* 40	* 47	* 42
Republic of Ireland (ROI)	* 29	* 12	* 23	* 18
OECD Trend Average	* 39	* 27	* 30	* 25

Gender gaps calculated as girls' reading score – boys' reading score.
Asterisks (*) in the table indicate that the gender gap shown represents a statistically significant difference.
OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

The trends in the gender gaps in Wales and the comparator countries since the 2012 cycle of PISA are further contextualised by Figure 6.6 and Figure 6.7. The two figures focus on the trends in the reading scores of girls and boys respectively. In Wales, girls scored significantly lower in PISA 2022 (475) than in 2018 (497) and 2012 (493), but the score in PISA 2022 was not significantly different to the score in 2015 (483). On the other hand, boys' reading performance showed a downward trend from 2015. Boys' reading score in PISA 2022 (456) was significantly lower than the score in 2018 (470) and 2015 (472), but not significantly different to the score in 2012 (466).

On average across OECD trend countries, girls and boys showed a downward trend in reading performance since 2012 and 2015 respectively. The OECD average for girls was significantly lower in PISA 2022 (490) than in 2018 (503), 2015 (504) and 2012 (513), and boys' reading score in PISA 2022 (465) was significantly lower than that in 2018 (473), 2015 (477) and 2012 (474).

The comparator countries showed different trends in reading performance between girls and boys since 2012. Netherlands showed a downward trend in girls' and boys' reading performance from 2012 respectively, with the reading scores of girls and boys significantly lower in PISA 2022 than in 2018, 2015 and 2012, respectively. Norway also showed a downward trend in girls' and boys' reading performance from 2015 respectively. In Norway, girls scored significantly lower in PISA 2022 (498) than in 2018 (523), 2015 (533) and 2012 (528), and boys scored significantly lower in PISA 2022 (456) than in 2018 (476), 2015 (494) and 2012 (481). In New Zealand, girls' reading performance showed a downward trend whereas boys' reading performance had little change since 2012. The reading score of girls in New Zealand was not significantly lower in PISA 2022 (514) than in 2018 (520), but was significantly lower than in 2015 (526) and 2012 (530), whereas the score of boys in PISA 2022 (488) was not significantly different to the scores in 2018 (491), 2015 (493) and 2012 (495). However, in the Republic of Ireland, the reading scores of girls and boys in PISA 2022 were not significantly different to those in the three previous PISA cycles, respectively.

Figure 6.6: Trends in girls' reading performance in Wales, comparator countries and on average across OECD trend countries

Girls' average reading score
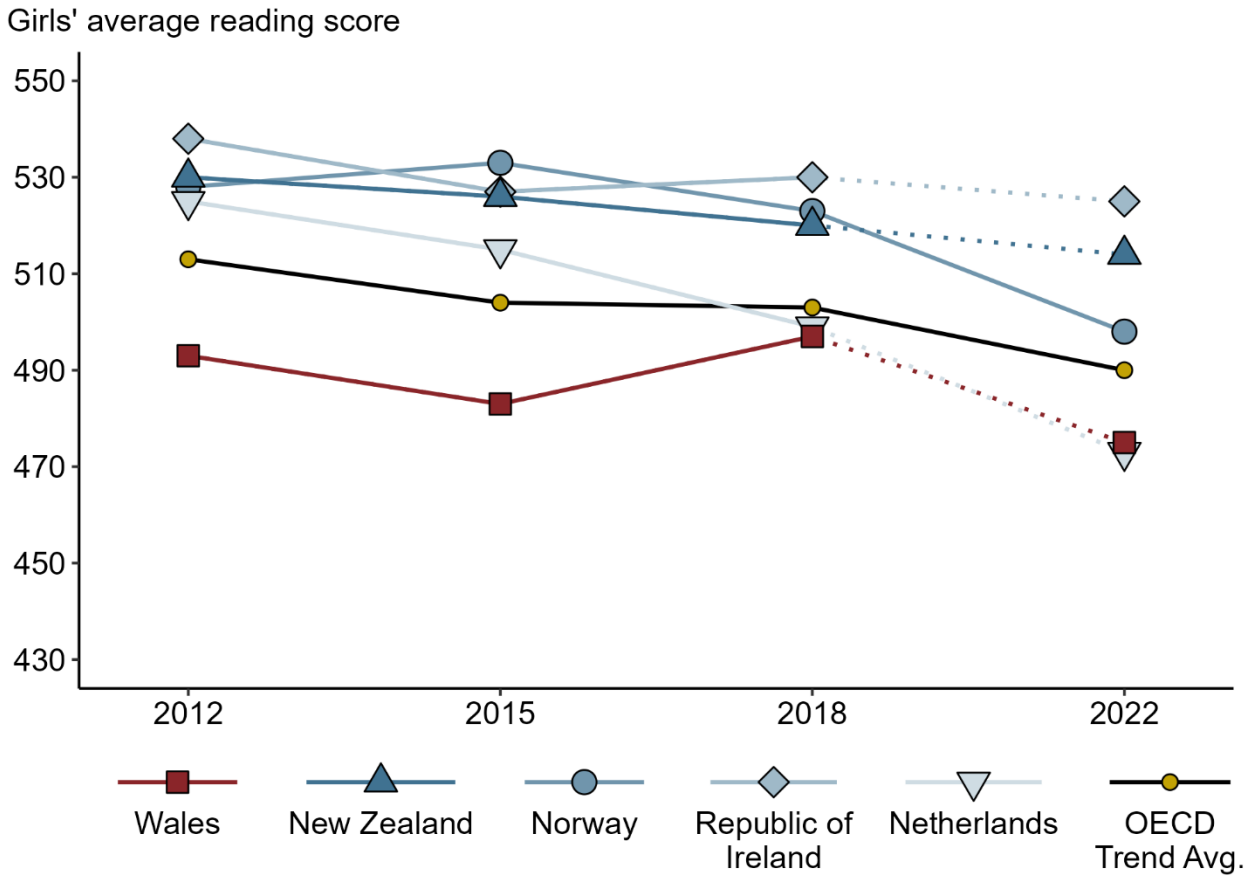
Country	2012	2015	2018	2022
Wales	* 493	483	* 497	475
Netherlands	* 525	* 515	* 499	473
New Zealand	* 530	* 526	520	514
Norway	* 528	* 533	* 523	498
Republic of Ireland (ROI)	538	527	530	525
OECD Trend Average	* 513	* 504	* 503	490

Asterisks (*) indicate that the score shown was significantly different to that system's score for PISA 2022.

*Trend results where PISA sampling standards were not all met indicated with dotted lines in the figure.
OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.*
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Figure 6.7: Trends in boys' reading performance in Wales, comparator countries and on average across OECD trend countries

Boys' average reading score

Country	2012	2015	2018	2022
Wales	466	* 472	* 470	456
Netherlands	* 498	* 491	* 470	447
New Zealand	495	493	491	488
Norway	* 481	* 494	* 476	456
Republic of Ireland (ROI)	509	515	506	507
OECD Trend Average	* 474	* 477	* 473	465

Asterisks (*) indicate that the score shown was significantly different to that system's score for PISA 2022. Trend results where PISA sampling standards were not all met indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

6.3.4 Science

Across previous cycles of PISA, the overarching findings across OECD countries were that girls typically outperform boys in PISA reading, while boys outperform girls in PISA mathematics. The findings relating to science have not been as consistent; in PISA 2018, there was a small, but statistically significant advantage of around 2 points favouring girls

in PISA Science. This contrasted with the results of the 2015 cycle, where boys in OECD countries scored around 3 points higher on average than girls did. In Wales girls significantly outperformed boys in science in PISA 2012, but since then, the differences in performance in science had been relatively small and have not represented statistically significant differences in girls' and boys' performance.

In PISA 2022, girls in Wales had an average science score of 469, compared to an average of 477 for boys. This 7 score point difference (after rounding) does not represent a statistically significant difference in performance. On average across OECD countries, there was also no significant difference in the performances of girls (485) and boys (485) in science.

Figure 6.8 shows the science performance of girls and boys in every participating education system with overall science scores greater than 400. The diagonal line on the figure shows the point where girls and boys score equally well. Education systems in which girls scored significantly higher than boys in science are shown in yellow above the line, while systems where boys scored significantly higher than girls are shown in blue below the line. In total, there were 20 systems with overall scores above 400 where girls scored significantly higher than boys, and 13 systems where boys scored significantly higher than girls. Finland, Qatar and the United Arab Emirates were the education systems in which girls most outperformed boys in science, while Chile, Costa Rica and Peru were the systems with the strongest relative performance of boys. Larger gender gaps, in either direction, tended to be more common in lower-performing systems, though boys scored significantly higher in the top-performing system in PISA 2022, Singapore.

Figure 6.8: Science performance of girls and boys in PISA 2022

Girls' average science score

Type of gender gap	Education system and gender gap size
Education systems in which girls scored significantly higher than boys in science – represented by yellow squares	Finland (+22), Qatar (+21), Jamaica (+20), United Arab Emirates (+17), Bulgaria (+16), Slovenia (+15), Mongolia (+15), Norway (+13), Malaysia (+13), Iceland (+13), Brunei (+12), Malta (+12), Croatia (+11), Thailand (+10), Greece (+10), Sweden (+8), Montenegro (+8), Moldova (+8), Lithuania (+6), Kazakhstan (+5)
Education systems in which boys scored significantly higher than girls in science – represented by blue diamonds	Costa Rica (−15), Peru (−14), Chile (−14), Mexico (−14), Austria (−11), Uruguay (−9), Denmark (−7), Singapore (−7), Colombia (−6), Vietnam (−6), Argentina (−6), Brazil (−5), Spain (−5)
Education systems without statistically significant gender gaps in science – represented by grey circles	United States (−7), Italy (−7), **Wales (−7)**, Republic of Ireland (−6), Hungary (−3), Taiwan (−3), Australia (−2), Netherlands (−2), Japan (−2), Macao (−2), Latvia (−1), Canada (−1), Germany (0), Switzerland (0), Belgium (0), Hong Kong (0), Israel (0), Ukrainian regions (+1), New Zealand (+1), Romania (+1), France (+1), Portugal (+2), Poland (+2), Czech Republic (+2), South Korea (+3), Estonia (+4), Serbia (+4), Turkey (+5), Slovakia (+7)

Base: All education systems with average scores over 400 in science in PISA 2022.
Gender gaps calculated as girls' science score – boys' science score and reported in parenthesis.
*Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.*

Figure 6.9 shows the trends in the gender gaps in Wales and the comparator countries since the 2012 cycle of PISA. These are further contextualised by Figure 6.10 and Figure 6.11, which focus on the trends in the average science scores of girls and boys respectively.

In PISA 2018, girls in Wales scored, on average, around 5 points higher in science than boys did. This was not a statistically significant result, but did contrast with previous performance in Wales, including a statistically significance difference favouring boys back in 2012. Figure 6.9 shows that in PISA 2022, the average score of boys in Wales was 7 points higher than the score of girls, but this does not represent a statistically significant difference.

There has been no significant difference between the performance of girls and boys in New Zealand since 2012. In the Republic of Ireland and in Italy, the difference between the performance of girls and boys was only significant in 2015. In contrast, girls have significantly higher average score than boys in science in Norway in 2018 and 2022.

Figure 6.9: Trends in gender gaps in science performance

Gender gaps calculated as girls' science score – boys' science score. Asterisks (*) in the table indicate that the gender gap shown represents a statistically significant difference.
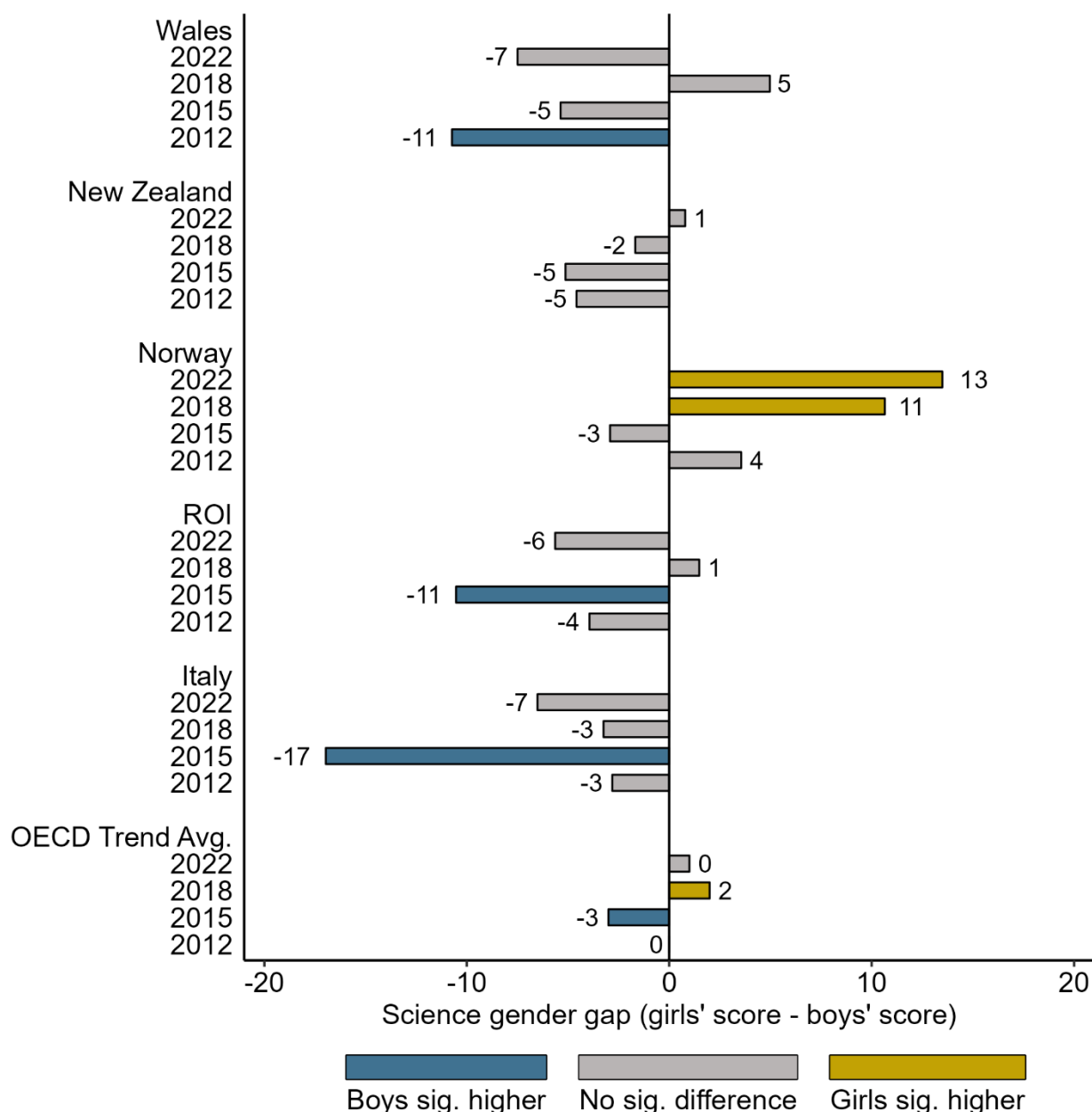
Country	2012	2015	2018	2022
Wales	* −11	−5	5	−7
New Zealand	−5	−5	−2	1
Norway	4	−3	* 11	* 13
Republic of Ireland	−4	* −11	1	−6
Italy	−3	* −17	−3	−7
OECD Trend Average	0	* −3	* 2	0

Gender gaps calculated as girls' science score – boys' science score. Asterisks (*) in the table indicate that the gender gap shown represents a statistically significant difference.

OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

This changing pattern can be seen in Figure 6.10 and Figure 6.11; the average science score of girls in Wales dropped by around 22 points from 2018 to 2022, while the average score of boys in Wales only dropped by around 9 points over the same period.

In Wales, the average performance of girls in science was significantly lower in 2022 (469) than in 2018 (491), 2015 (482) and 2012 (485). The majority of the comparator countries saw no significant difference in the average score for girls between 2018 and 2022 with the exception of Norway where there was a significantly lower score in 2022 of 485 than in 2018 (496). On average across OECD trend countries the average scores for girls have been relatively stable since 2015, though the average score for girls in 2012 was significantly higher than the score in 2022.

Figure 6.10: Trends in girls' science performance in Wales, comparator countries and on average across OECD trend countries

Girls' average science score

Asterisks (*) indicate that the score shown was significantly different to that system's score for PISA 2022.
Trend results where PISA sampling standards were not all met indicated with dotted lines in the figure.
OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Country	2012	2015	2018	2022
Wales	* 485	* 482	* 491	469
New Zealand	513	511	508	504
Norway	496	* 497	* 496	485
Republic of Ireland	* 520	497	497	501
Italy	* 492	472	466	474
OECD Trend Average	* 498	489	490	487

Source: OECD, PISA 2022

The performance of boys in Wales has been stable since 2015, with no significant differences between the average score in 2022 (477) in science and the average score in 2018 (486) and 2015 (487). However, the average score for boys in science in 2022 was significantly lower than the score in 2012 (496). New Zealand also saw no significant difference between their boy's performance in science in 2022 and 2018. In Norway, the

average score for boys in science was significantly lower in 2022 than in 2018, dropping from 485 to 472. In the Republic of Ireland and in Italy there was a significant increase in the average boys score in science from 495 and 470 respectively in 2018 to 507 and 481 respectively in 2022. On average across OECD trend countries there was no significant difference between the scores for boys in 2022 and 2018, but the average score for boys in 2022 (486) was significantly lower than in 2015 (492) and 2012 (499).

Figure 6.11: Trends in boys' science performance in Wales, comparator countries and on average across OECD trend countries

Boys' average science score
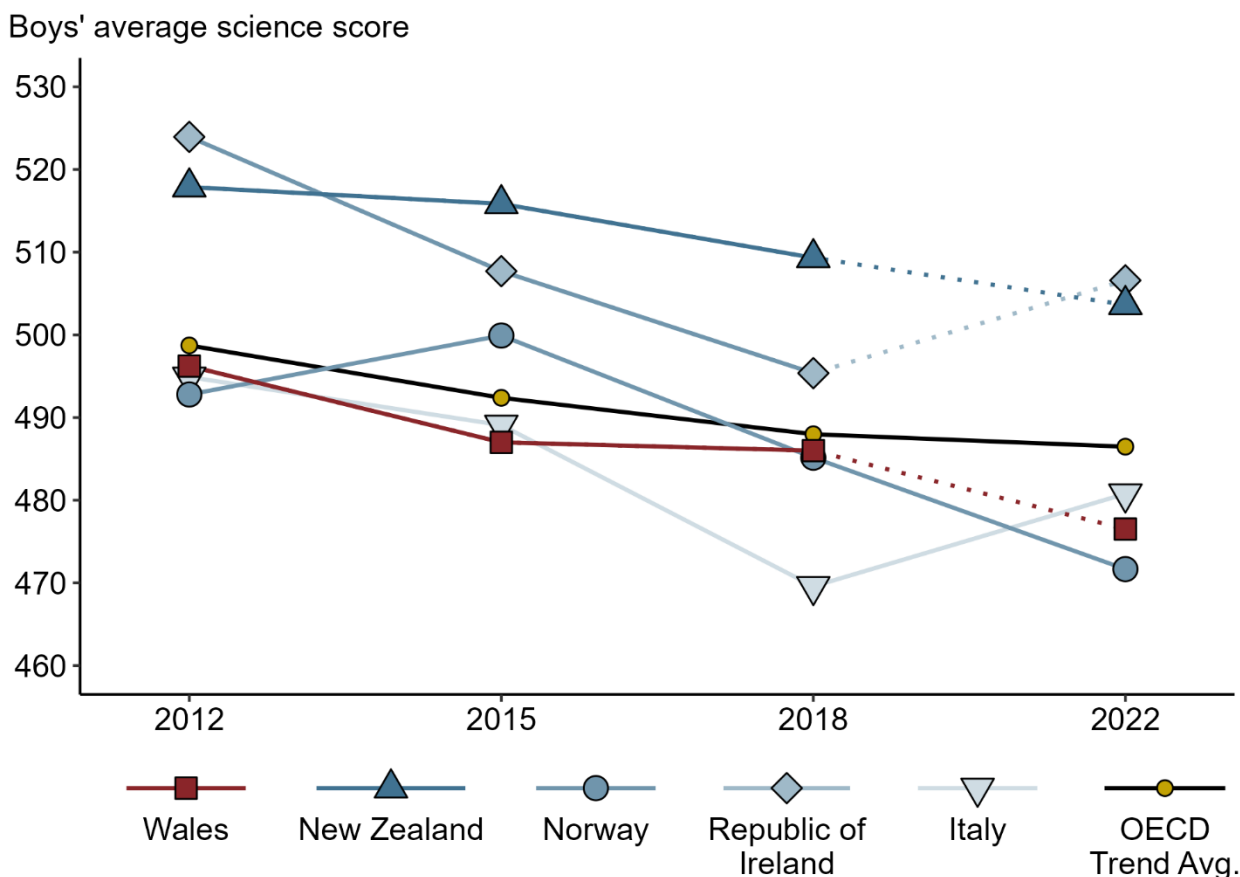
Country	2012	2015	2018	2022
Wales	* 496	487	486	477
New Zealand	* 518	* 516	509	504
Norway	* 493	* 500	* 485	472
Republic of Ireland	* 524	508	* 495	507
Italy	* 495	489	* 470	481
OECD Trend Average	* 499	* 492	488	486

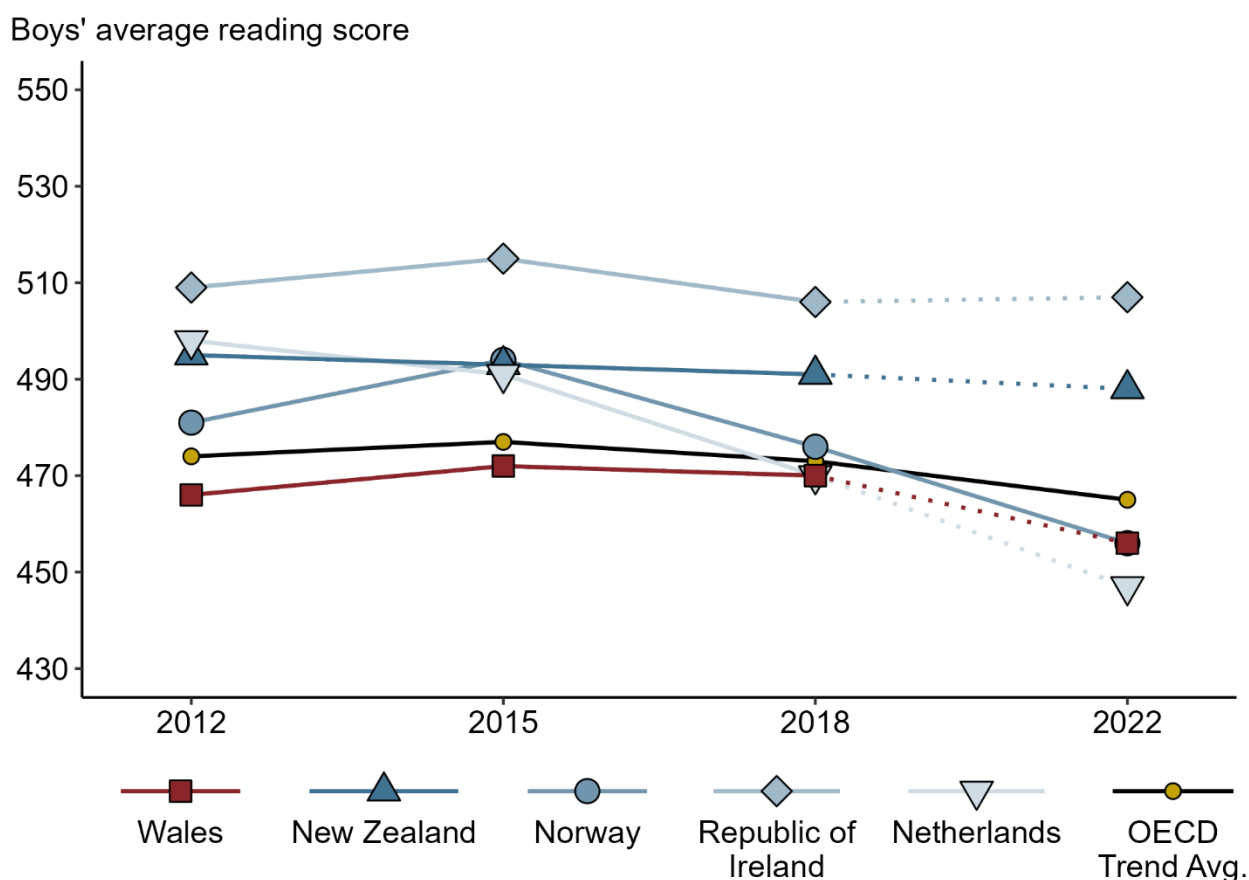*Asterisks (*) indicate that the score shown was significantly different to that system's score for PISA 2022. Trend results where PISA sampling standards were not all met indicated with dotted lines in the figure. OECD trend averages calculated using OECD countries in PISA 2022 excluding Costa Rica, Luxembourg and Spain.*

Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included education systems. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

6.4   Socioeconomic background

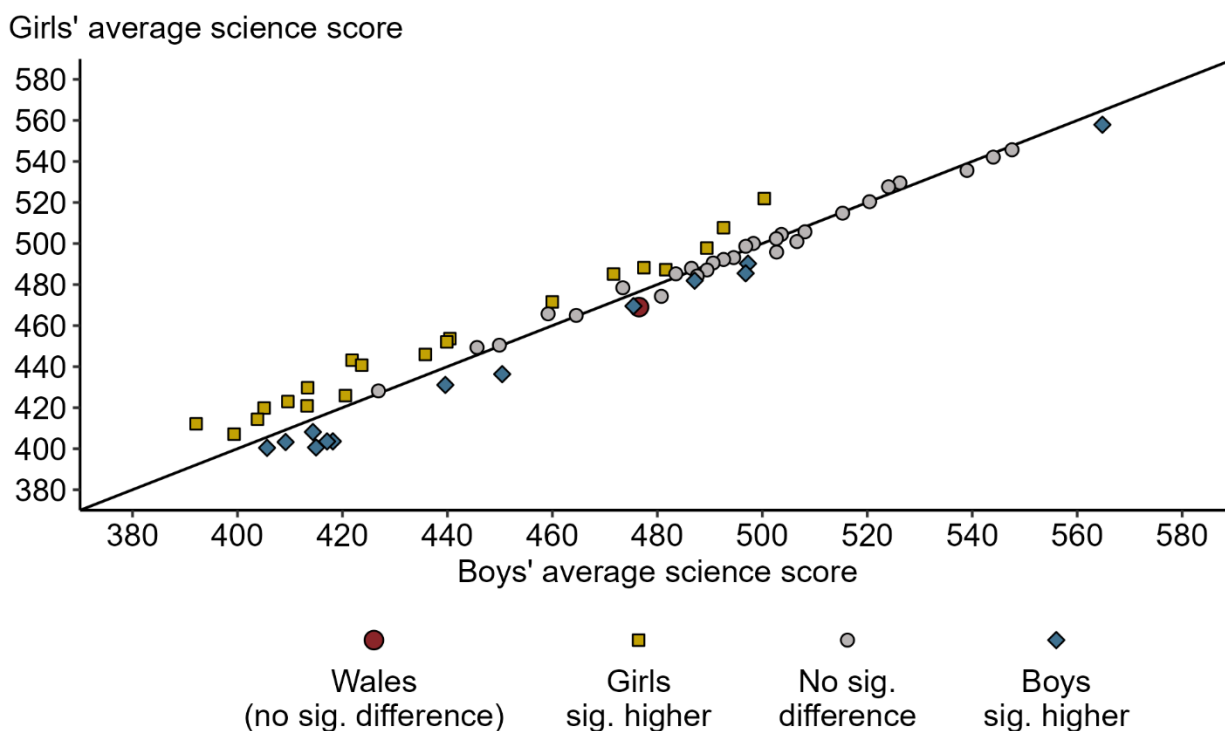This section reports on how mathematics, reading and science scores vary by learners' socioeconomic background. Two measures of socioeconomic background are employed, PISA's economic, social and cultural status (ESCS) index, which is described below, and

learner eligibility for free school meals (FSM), which was derived from the Pupil Level Annual School Census (PLASC) database.

Socioeconomic background in PISA is reported as the ESCS (economic, social and cultural status) Index. This was based on learners' responses to questions about their parents' background and education and possessions in their homes. The Index was set to a mean of approximately 0 across OECD countries, with a standard deviation of 1. This index was calculated differently in PISA 2022 to previous cycles of PISA. Comparisons with previous cycles in this report are made using this new index rather than those reported in the previous national reports for Wales.

Wales' mean score on the ESCS Index was +0.07 indicating that, on average, learners in Wales had a higher socioeconomic status than the average across OECD countries. However, the data needed for the ESCS Index were missing for 16% of learners in Wales. In 2018 using the new ESCS Index the mean score in Wales was +0.10. Data needed for the ESCS Index were missing for 9% of learners in Wales in 2018.

There are 2 different ways to think about the relationships between socioeconomic status and attainment. The first is to consider the difference in attainment between average learners with high socioeconomic status and those with low socioeconomic status. This is referred to as the size of the effect and can be seen as the 'steepness of the slope' (the gradient of the line) when plotting the relationship between socioeconomic status and attainment. Another way to look at the size of the effect is to divide learners into 4 equal groups (quartiles) according to their ESCS score and examine the gap between learners in the most disadvantaged group compared to the least disadvantaged group[14].

The second way to think about the relationships between socioeconomic status and attainment is to consider how much variation in attainment there is between learners of the same socioeconomic status, or to put it another way, how strongly correlated socioeconomic status is with attainment. If there is a strong correlation, then there will be less variability in the attainment of learners with the same socioeconomic status, which implies that socioeconomic status is the dominant factor in determining outcomes. A low percentage of the variance in performance being explained by socioeconomic status means that socioeconomic status has less of an influence on performance in PISA. This is referred to as the strength of the effect.

6.4.1 Mathematics

In Wales there was a 33 score point difference in mathematics performance associated with a one-unit increase in ESCS. Across OECD countries, there was a 39 OECD score-point difference in mathematics performance associated with a one-unit increase in

---

[14] These groups were based on the percentage of learners after the application of weights, rather than before. In terms of the raw numbers of learners, 553 learners in Wales were classified as being in Quartile 4, compared to just 530 in Quartile 1. After the application of weights, there is an equal distribution of learners in all four quartiles

ESCS. The score point difference in Wales was significantly smaller than the average score point difference across OECD countries. In New Zealand there was a 42 score point difference in mathematics performance associated with a one-unit increase in ESCS, which was significantly larger than the score point difference in Wales. In Norway and the Republic of Ireland this was a 35 score point difference, and in Croatia there was a 38 score point difference in mathematics performance associated with a one-unit increase in ESCS. These score point differences in mathematics were not significantly different from the score point difference in mathematics in Wales.

In Wales there was a 76 score point difference (after rounding) between the most disadvantaged group and the least disadvantaged group. This was significantly smaller than the OECD difference of 93 score points (after rounding) as shown in Figure 6.12. In Wales and on average across OECD countries, more disadvantaged learners achieved lower mathematics scores than their less disadvantaged peers, and this was true for each quartile. The score point difference in mathematics in Wales was significantly smaller than the score point difference in mathematics in New Zealand (102). There were no significant differences between the score point differences in Croatia (82), the Republic of Ireland (74) or Norway (81) and the score point difference between the most disadvantaged group and the least disadvantaged group in Wales.

Figure 6.12: Mathematics performance by ESCS Index quartile in Wales and on average across OECD countries

Average mathematics score
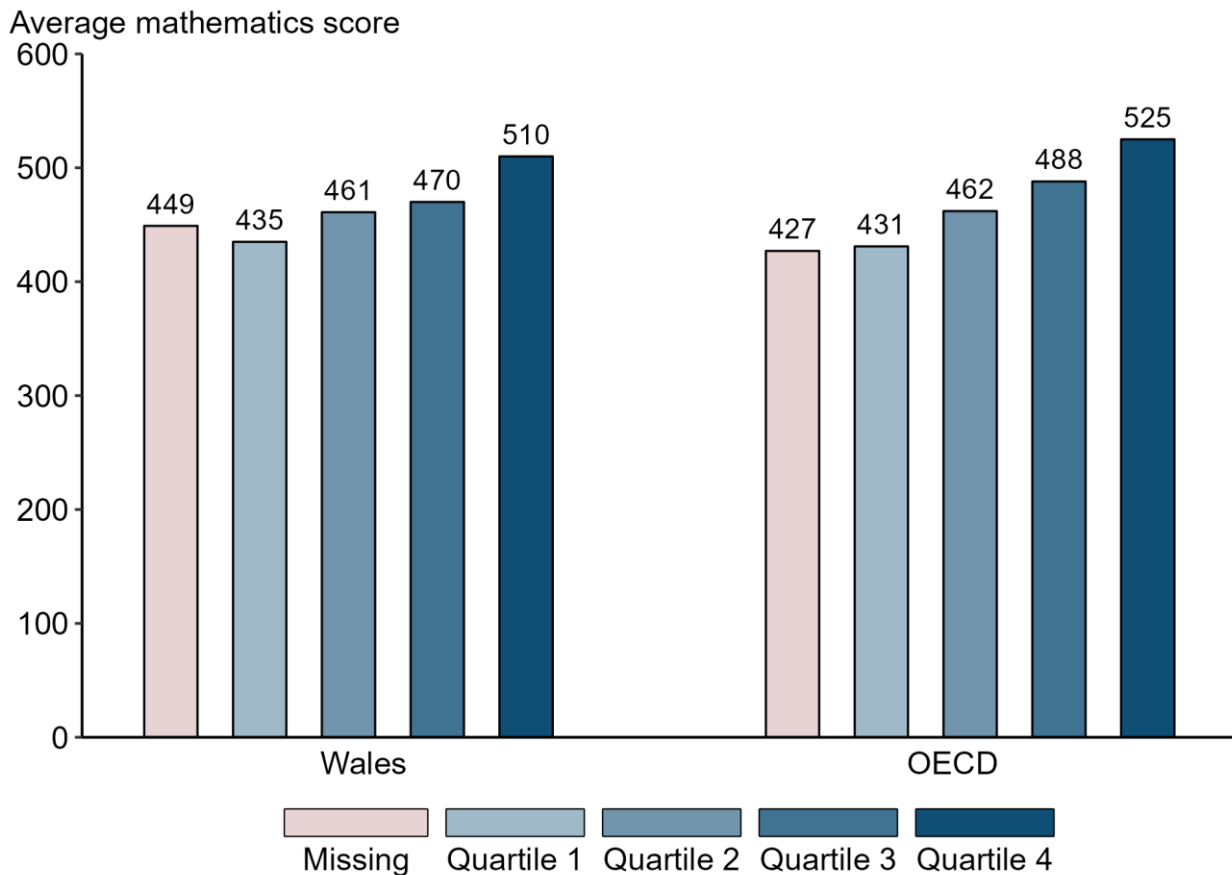
Country	Missing	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Wales	449	435	461	470	510
OECD Average	427	431	462	488	525

'Missing' or unavailable ESCS data for 16% of learners in Wales and around 6% of learners across the OECD.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

The percentage of the variance in mathematics performance explained by socioeconomic status in Wales was 10%. On average across OECD countries 15% of the variance in mathematics performance was explained by the ESCS Index. In New Zealand, 16% of the variance in mathematics performance was explained by the ESCS Index, with 13% in the Republic of Ireland and Croatia, and 10% in Norway.

The ESCS Index also allows us to compare the percentage of learners who succeed academically despite their socioeconomic background, that is, who are academically resilient. A learner is classified as resilient if they are in the bottom quarter of the ESCS Index in the country of assessment and perform in the top quarter of learners in that

country. In Wales, 13% of learners were academically resilient, which was not significantly different to the average across OECD countries (10%).

6.4.1.1 Mathematics performance by learners' free school meal (FSM) eligibility

In Wales the national measure usually used to understand the effects of disadvantage was eligibility for free school meals (FSM). Eligibility for free school meals divides learners into 2 groups, those eligible for free school meals and those not eligible. Table 6.3 presents the average mathematics scores for these groups of learners. The analysis was carried out with learner data which was matched to the Wales Pupil Level Annual School Census (PLASC) database. On average learners eligible for free school meals performed significantly lower in mathematics than learners not eligible for free school meals.

Table 6.3: FSM eligibility and PISA mathematics scores in Wales

FSM eligibility	Percentage of learners	Average mathematics score
Not eligible for FSM	87%	471
Eligible for FSM	13%	423

Base: All learners with known FSM eligibility (97% weighted percentage).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022 and Welsh Government

6.4.2 Reading

In Wales there was a 28 score point difference in reading performance associated with a one-unit increase in ESCS. On average across OECD countries there was a 39 score point difference in reading performance associated with a one-unit increase in ESCS. The score point difference in Wales was significantly smaller than the average score point difference across OECD countries. The score point difference in reading performance in Wales (28) was also significantly smaller than the score point difference in the Netherlands (46), New Zealand (39), Norway (39) and the Republic of Ireland (36).

Figure 6.13 shows the overall reading performance of learners in Wales and on average across OECD countries broken down into the four ESCS quartiles described in the introduction to this chapter. Figure 6.13 shows that, both in Wales and across the OECD countries, relative socioeconomic advantage was associated with stronger performance in PISA reading. In Wales, the most disadvantaged group scored significantly lower in reading (441) than the least disadvantaged group (506). On average across OECD countries the most disadvantaged group scored significantly lower in reading (434) than the least disadvantaged group (527).

Figure 6.13: Reading performance of learners in Wales and on average across OECD countries by their ESCS Quartile
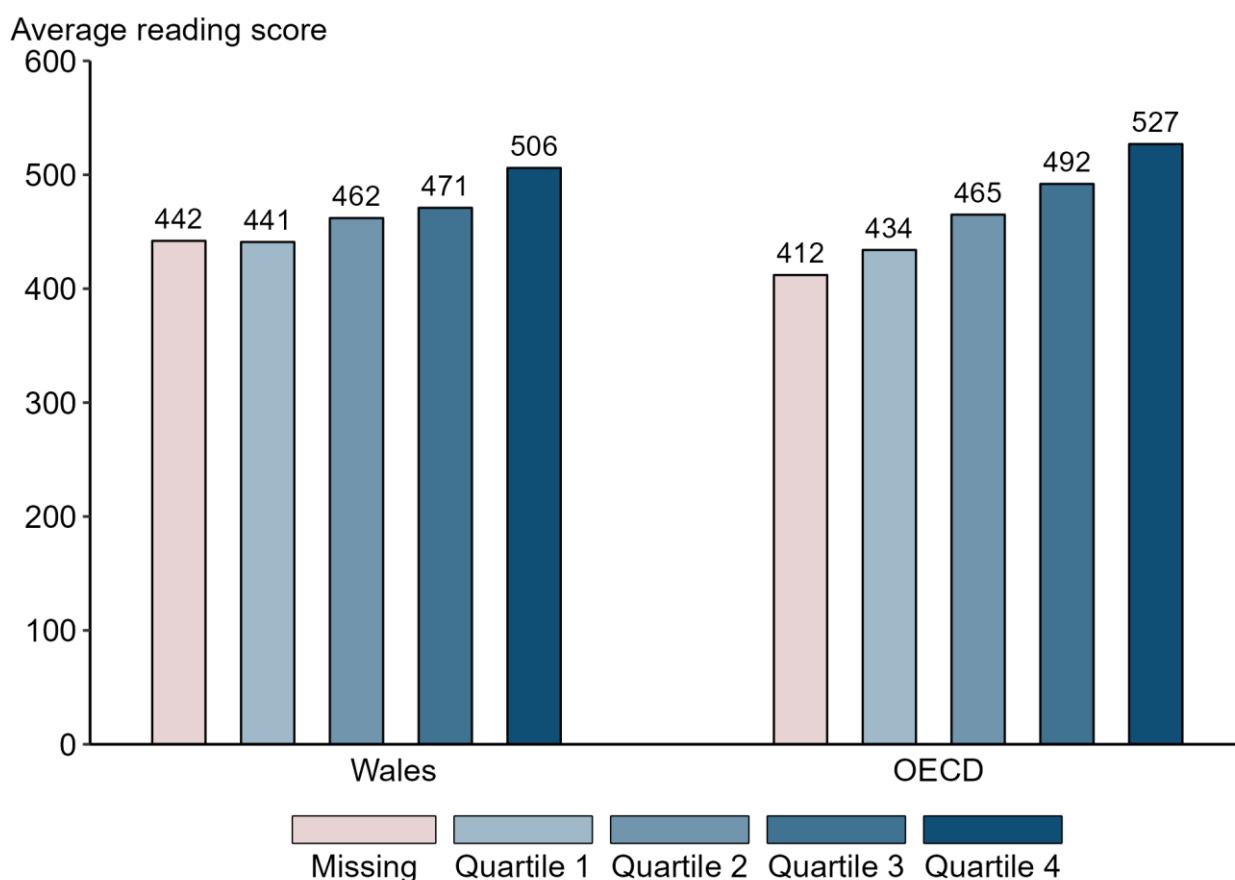
Country	Missing	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Wales	442	441	462	471	506
OECD Average	412	434	465	492	527

'Missing' or unavailable ESCS data for 16% of learners in Wales and around 6% of learners across the OECD.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

The performance gap in reading between learners in the most disadvantaged group (Quartile 1) and learners in the least disadvantaged group (Quartile 4) in Wales was 65 score points. This was not significantly different from the performance gap in reading in the Republic of Ireland (76) but was significantly smaller than the performance gaps in the Netherlands (103), New Zealand (94) and Norway (89). It was also significantly smaller than the average performance gap across the OECD (93 score points).

The percentage of the variation in reading performance explained by the ESCS index in Wales was 6%. On average across OECD countries 13% of the variation in reading performance was explained by the ESCS index. The percentage of the variation in

reading performance explained by the ESCS index in the Netherlands was 12%, in the Republic of Ireland and New Zealand was 11%, and in Norway it was 8%.

The percentage of academically resilient learners in reading in Wales was 17%, significantly higher than the average across OECD countries (11%). In New Zealand the percentage of academically resilient learners in reading was also 11%, while in the Netherlands and Norway it was 12%, and in the Republic of Ireland it was 13%.

6.4.2.1   Reading performance by learners' free school meal eligibility

Table 6.4 presents the average reading scores for learners eligible for free school meals and learners who were not eligible. The analysis was carried out with learner data which was matched to the Wales learner level annual school census database. On average learners eligible for free school meals performed significantly lower in reading in PISA 2022 than learners not eligible for free school meals.

Table 6.4: FSM eligibility and PISA reading scores in Wales

FSM eligibility	Percentage of learners	Average reading score
Not eligible for FSM	87%	471
Eligible for FSM	13%	429

Base: All learners with known FSM eligibility (97% weighted percentage).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022 and Welsh Government

6.4.3 Science

In Wales there was a 35 score point difference in science performance associated with a one-unit increase in ESCS. On average across OECD countries there was a 41 score point difference in science performance associated with a one-unit increase in ESCS. The score point difference in science performance in Wales was significantly smaller than the average across OECD countries. The score point difference in Wales was also significantly smaller than the score point difference in science performance in New Zealand (44) but was not significantly different from the score point difference in Italy (36), Norway (39) or the Republic of Ireland (37). Figure 6.14 shows that, both in Wales and across the OECD, relative socioeconomic advantage was associated with stronger performance in PISA science.

Figure 6.14: Science performance of learners in Wales and on average across OECD countries by their ESCS Quartile

Country	Missing	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Wales	456	441	466	476	522
OECD Average	436	442	473	501	538

'Missing' or unavailable ESCS data for 16% of learners in Wales and around 6% of learners across the OECD.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

The performance gap in science between learners in the most disadvantaged group (Quartile 1) and the least disadvantaged group (Quartile 4) in Wales was 81 score points which was significantly smaller than the performance gap on average across OECD countries of 96 score points. This performance gap in science in Wales was not significantly different from the performance gap in science in Italy (88), the Republic of Ireland (78) or Norway (90) but was significantly smaller than the performance gap in science in New Zealand (106).

The percentage of the variation in science performance explained by the ESCS index in Wales was 9%. On average across OECD countries 14% of the variation in science performance was explained by the ESCS index. The percentage of the variation in

science performance explained by the ESCS index in New Zealand was 15%, in Italy was 13%, in the Republic of Ireland was 11%, and in Norway 9% of the variation in science performance was explained by the ESCS index.

The percentage of academically resilient learners in science in Wales was 14% while on average across OECD countries 11% of learners were academically resilient in science (though this difference was not statistically significant). In Italy the percentage of academically resilient learners was also 11%. In New Zealand it was 9% of learners and in Norway and the Republic of Ireland it was 13% of learners who were academically resilient in science.

6.4.3.1   Science performance by learners' free school meal (FSM) eligibility

Table 6.5 presents the average science scores for the learners in Wales or were eligible for free school meals and who were not eligible. The analysis was carried out with learner data which was matched to the Wales Pupil Level Annual School Census (PLASC) database. On average learners eligible for free school meals performed significantly lower in science than learners not eligible for free school meals.

Table 6.5: FSM eligibility and PISA science scores in Wales

FSM eligibility	Percentage of learners	Average science score
Not eligible for FSM	87%	478
Eligible for FSM	13%	430

Base: All learners with known FSM eligibility (97% weighted percentage).

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022 and Welsh Government

6.5   Immigration background and language

The learner questionnaire in PISA 2022 collects information which enables us to identify whether learners were first- or second-generation immigrants. Immigrant background is defined in the OECD International report as:

- Non-immigrant learners were learners whose mother or father (or both) was/were born in the country where the learner sat the PISA test, regardless of whether the learner him/herself was born in that country.

- First-generation immigrant learners were learners born in another country whose parents were also born in another country.

- Second-generation immigrant learners were learners born in the country of assessment but whose parents were both born in another country.

The International report notes that the percentage of learners across the OECD countries with an immigrant background has increased from 12% in 2018 to 13% in 2022. In Wales the percentage of learners with an immigrant background was 9%, which was significantly below the OECD average, though data were not available for the immigration status of 16% of the learners in Wales.

The performance of learners with an immigrant background tends to be lower than their non-immigrant peers. Across OECD countries, the average mathematics score for learners with an immigrant background (first-generation or second-generation) was 447, which was 30 score points lower than the performance of non-immigrant learners.

Table 6.6 shows the mean mathematics score for learners with different immigration backgrounds. In Wales both learners with a second-generation or a first-generation immigrant background had a higher mathematics score on average (481) than learners without an immigrant background (468). On average across OECD countries learners with a second-generation immigrant background had a higher mean mathematics score (458) than learners with a first-generation immigrant background (435) but learners without an immigrant background had the highest mathematics performance with an average score of 479. In Wales, the average score for learners with a non-immigrant background was significantly lower than the scores for the corresponding group of learners on average across OECD countries, while the average score for learners with a first-generation immigration background was significantly higher than the average across OECD countries. There was no significant difference between the average score in mathematics in Wales and the score on average across the OECD countries for learners with a second-generation immigrant background.

Table 6.6: Immigration background and PISA mathematics scores in Wales

Immigration background	Percentage of learners	Mean mathematics score
Learners without an immigrant background	75%	468
Learners with a first-generation immigrant background	4%	481
Learners with a second-generation immigrant background	5%	481
Immigrant status unknown	16%	450

Base: 2,143 learners (83% weighted percentage)
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022

In reading the average score for learners with a non-immigrant background was 469 which was not significantly different from the average scores for learners with a first-generation immigrant background (484) or for learners with a second-generation immigrant background (483). On average across OECD countries the average score for reading in PISA 2022 for learners with a non-immigrant background was 483, with an average score of 461 for learners with a second-generation immigrant background and an average score of 425 for learners with a first-generation immigrant background. The average score in reading for learners with a non-immigrant background in Wales was significantly lower than the average across OECD countries for these learners while the average score for learners with a first-generation immigrant background in Wales was significantly higher than the average across OECD countries for these learners. There were no significant differences between the average scores in reading for learners with a second-generation immigrant background in Wales and on average across OECD countries.

The average score in science for learners with a non-immigrant background was 474 which was not significantly different from the average score for learners with a second-generation immigrant background (483) or for learners with a first-generation immigrant background (491). On average across OECD countries the average score for science in PISA 2022 for learners with a non-immigrant background was 492, with an average science score of 466 for learners with a second-generation immigrant background and an average score of 438 for learners with a first-generation immigrant background. The average score in science for learners with a non-immigrant background in Wales was significantly lower than the average across OECD countries for these learners while the average score for learners with a first-generation immigrant background in Wales was significantly higher than the average across OECD countries for these learners. There were no significant differences between the average scores in science for learners with a second-generation immigrant background in Wales and on average across OECD countries.

Learners were also asked about the language they spoke at home. Table 6.7 shows the mathematics, reading and science scores of learners who speak English or Welsh at home compared with learners who speak another language at home. There were no significant differences in the average scores in mathematics, reading or science between learners who speak English or Welsh at home (468, 469 and 475 respectively) and learners who speak another language at home (458, 460 or 465 respectively).

Table 6.7: Language spoken at home and PISA mathematics scores in Wales

PISA 2022 domain	English or Welsh spoken at home	Another language spoken at home
Mathematics	468	458
Reading	469	460
Science	475	465

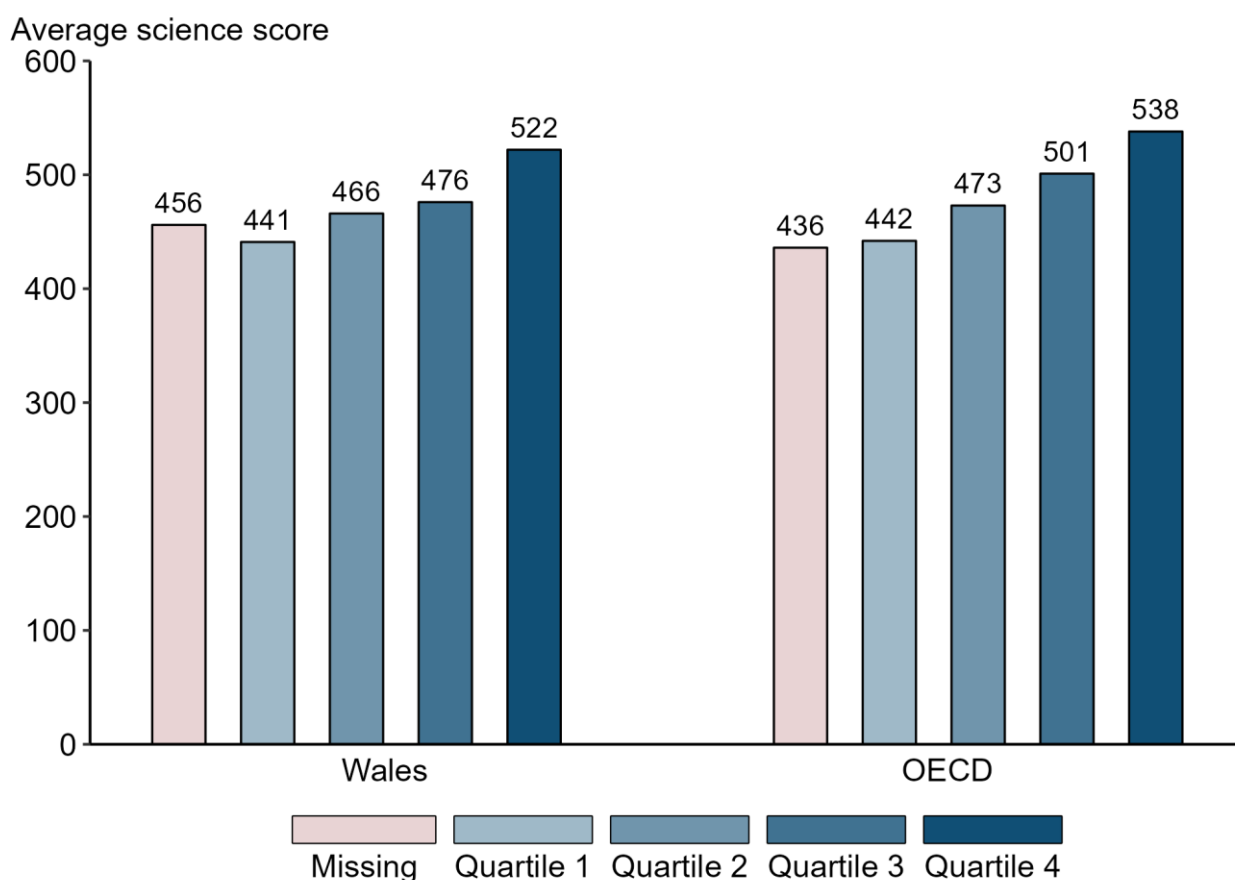*Base: 2,212 learners (86% weighted percentage of learners)*
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022

6.6 Additional learning needs

In this section we report on the performance of learners in mathematics, reading and science who have or do not have additional learning needs (ALN) as recorded in the Pupil Level Annual School Census. Learners with ALN that prevent them from accessing the PISA assessments are excluded from participating. Learners with ALN performed significantly lower in all the PISA 2022 domains than learners who did not have ALN. In mathematics learners without ALN had an average score of 468 while learners with ALN had an average score of 419. In the reading domain learners without ALN had an average score of 468 compared to learners with ALN who had an average score of 425. Finally, in science learners without ALN had an average score of 474 while learners with ALN had an average score of 431.

Table 6.8: PISA 2022 domain scores for learners with or without additional learning needs in Wales

PISA 2022 domain	No additional learning needs	Additional learning needs	Additional learning status unknown
Mathematics	468	419	523
Reading	468	425	500
Science	474	431	531

Base: 2,458 learners (97% weighted percentage of learners)
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD PISA 2022 and Welsh Government

7 Learner wellbeing, aspirations and experiences of teaching and learning

7.1 Chapter overview

This chapter focuses on how learners in Wales responded to questions relating to their wellbeing, future aspirations and their experiences of teaching and learning in the learner questionnaire, and how these relate to performance in PISA Mathematics. The chapter begins by looking at how learners in Wales rated their overall life satisfaction, as well as their experiences of bullying and perceptions of safety at school, and whether they feel like they socially belong at their schools. The chapter then looks at whether learners in Wales have beliefs conducive to a growth mindset and looks at learners' academic aspirations. The chapter concludes by looking at learners' experiences of teaching and learning.

7.2 Key findings

- Learners in Wales report significantly lower levels of overall life satisfaction than the average across OECD countries (6.16 and 6.75 respectively).

- About a fifth of learners in Wales (20%) report that they are made fun of at school at least a few times a month. On average across the OECD, learners who report more regular bullying at school score significantly lower in PISA mathematics than those who report no or very infrequent experiences of being bullied. A similar trend was noted for learners who do not feel safe at school.

- Learners in Wales are slightly less positive about their sense of belonging at school than learners on average across the OECD with 63% agreeing that they felt like they belong at school compared to 75% on average across OECD countries. Learners in Wales and on average across the OECD who reported feeling like they belong at school had significantly higher average mathematics scores on average than learners who did not feel this way.

- Around 60% learners in Wales believe that some people are just not good at mathematics, Welsh/English, or being creative, no matter how hard they try.

7.3 Introduction

The PISA 2022 learner questionnaire contains a large number of questions relating to learners' attitudes and beliefs, experiences in school, and hopes for the future.

The questions used in the learner questionnaire vary in how the question is asked, and the options that are available for learners' responses. Most questions asked learners to state how strongly they agreed with a given statement, e.g. "I feel nervous about

approaching exams". In some cases, four options (strongly agree, agree, disagree, strongly disagree) could be chosen, and in others, learners could also select a 'neither agree nor disagree' option. Other questions asked learners to report the frequency of a given event, e.g. "Other learners made fun of me" and were given 4 options to report their frequency; "never or almost never", "a few times a year", "a few times a month" or "once a week or more". In a few cases, such as when asked to rate their overall life satisfaction, learners were asked to rate themselves on a scale, usually between 0 and 10. Throughout this chapter, we will report the types of questions learners were asked, and how they were asked to respond.

It is important to note that the learner response rate in Wales was below the rate required by the OECD (80%) as described in Section 1.4.2. This means that it is possible that the findings reported here do not reflect an accurate picture of the national situation.

It is also important to note that not all learners who did respond to the questionnaire answered all possible questions. In order to mitigate this risk, this chapter only includes questions that had responses from at least 60% of the learners in Wales who participated in PISA 2022. Each table includes information about the proportion of learners that answered the questions included in the table. However, the national results reported in this chapter should still be interpreted with caution.

7.4 Learners' wellbeing

In this section, we focus on a number of questions relating to learners' wellbeing. These include questions about learners' satisfaction with different aspects of their lives, beliefs about their abilities, and feelings related to school.

7.4.1 Learners' life satisfaction

Learners were asked to rate their overall life satisfaction on a scale from 0 to 10, with 0 indicating very low life satisfaction, and 10 indicating very high satisfaction. Figure 7.1 shows the proportion of learners in Wales reporting each level of overall life satisfaction, compared to the average across all participating OECD countries. The individual ratings have been collapsed into five categories for the purpose of presentation; ratings of 0, 1 or 2, 3 (not satisfied) or 4, 5 or 6 (somewhat satisfied), 7 or 8 (satisfied), or 9 or 10 (very satisfied). There are no statistically significant differences between the proportion of learners in Wales reporting each level of overall life satisfaction and the proportion of learners on average across OECD countries. Relative to the OECD average, learners in Wales reported significantly lower levels of life satisfaction (6.16). On average across OECD countries, learners reported 6.75 on this life-satisfaction scale.

Figure 7.1: Self-reported overall life satisfaction scores of learners in Wales and on average across OECD countries
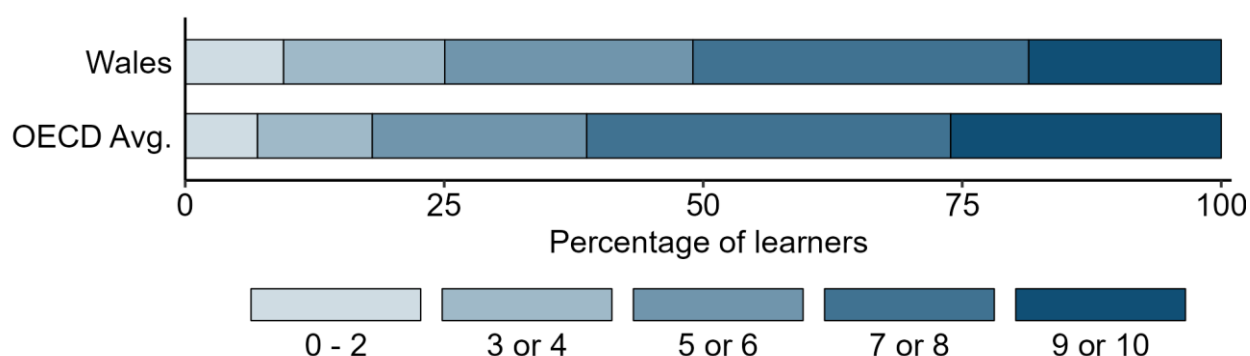
Education system	0 – 2	3 or 4	5 or 6	7 or 8	9 or 10
Wales	9%	16%	24%	32%	19%
OECD Average	7%	11%	21%	35%	26%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from 2,186 learners (85% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met in some of the included countries. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST016

Learners in Wales who reported their overall life satisfaction as a 7 or 8 out of 10 had the highest average PISA Mathematics scores (486). This was significantly higher than all other groups of learners. The average mathematics scores for each rating of life satisfaction are given in Table 7.1.

Table 7.1: Mathematics performance of learners in Wales with different levels of life satisfaction

Life satisfaction	Rating	Average mathematics score
Not satisfied	0 to 2	445
Slightly satisfied	3 or 4	469
Somewhat satisfied	5 or 6	459
Satisfied	7 or 8	486
Very satisfied	9 or 10	462

Wales data based on responses from 2,186 learners (85% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

7.4.2 Learners' perceptions of school safety

Learners were also asked about whether they felt safe at school, including on their travel to and from school. Learners were asked if they agreed with 4 statements shown in Table 7.2, ("strongly disagree", "disagree", "agree", "strongly agree"). In all 4 statements, the vast majority of learners in Wales agreed or strongly agreed that they felt safe at school and travelling to and from school. For each of the statements, the proportion of learners in Wales who agreed or strongly agreed was not statistically significantly different from the proportion of learners on average across OECD countries.

Table 7.2: Proportion of learners in Wales and on average across OECD countries agreeing with statements about their perceptions of safety at their school

Statement	Wales	OECD
I feel safe on my way to school	94%	92%
I feel safe on my way home from school	92%	91%
I feel safe in my classrooms at school	92%	93%
I feel safe at other places at school (e.g. hallway, cafeteria, toilets)	84%	90%

Percentages based on the proportion of learners who agreed, or strongly agreed with the given statement. Wales data based on responses from between 2199 and 2,200 learners (85% or 86% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST265

For all the different places listed, learners in Wales who reported feeling safe scored more highly in mathematics than learners who did not. Learners in Wales who agreed or strongly agreed that they felt safe in their classrooms in school had an average score in mathematics 42 score points higher than learners who disagreed or strongly disagreed. This is slightly larger than the difference of 39 score points on average across OECD countries. Figure 7.2 shows the mathematics score point differences between learners who agreed or strongly agreed and learners who disagreed or strongly agreed with whether they feel safe in different locations in Wales and on average across OECD countries.

Figure 7.2: Mathematics performance score difference between learners who felt safe in different places in Wales and on average across OECD countries
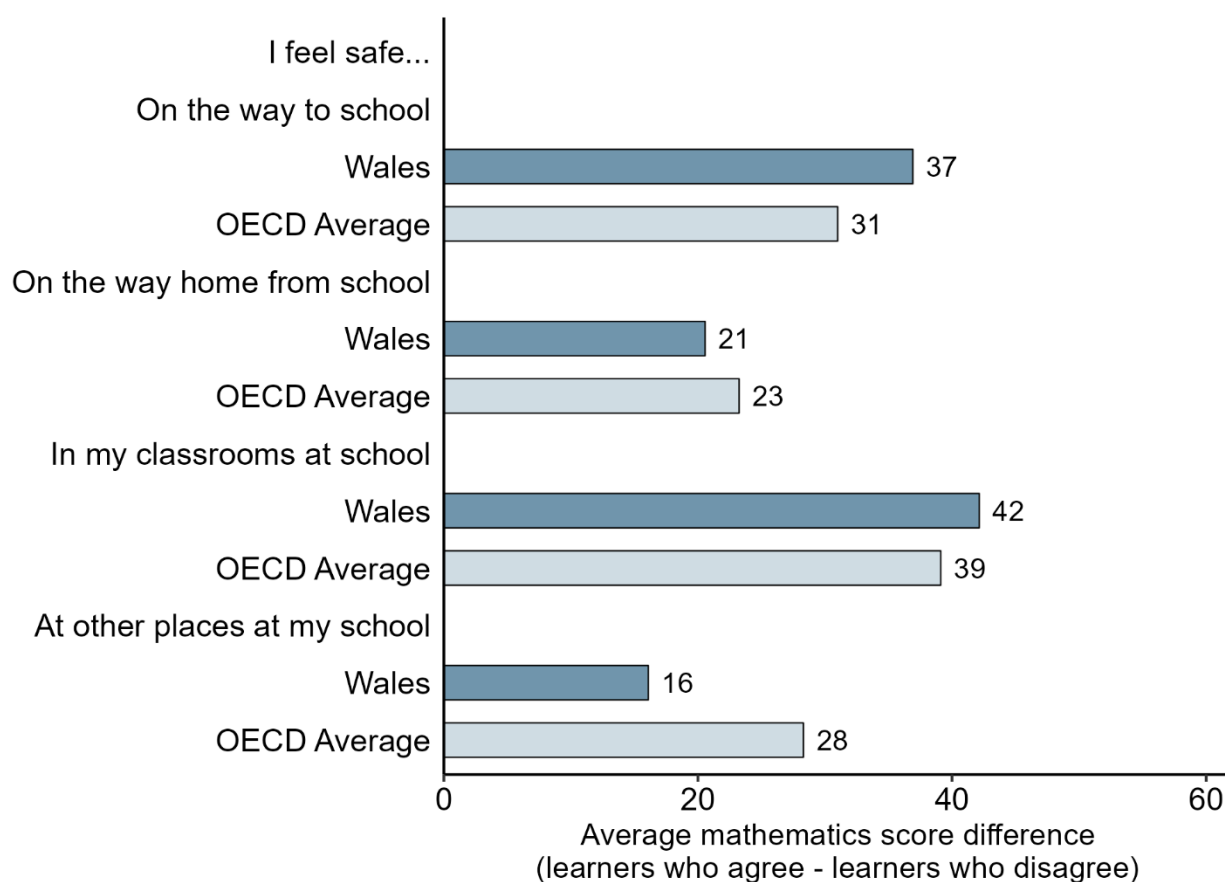
Statement	Wales	OECD
I feel safe on my way to school	37	31
I feel safe on my way home from school	21	23
I feel safe in my classrooms at school	42	39
I feel safe at other places at school (e.g. hallway, cafeteria, toilets)	16	28

Wales data based on responses from between 2199 and 2,200 learners (85% or 86% weighted learner response rate).
Difference in score calculated as average score of learners who agreed or strongly agreed – average score of learners who disagreed or strongly disagreed.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST265

7.4.3 Learners' sense of belonging at school

Table 7.3 shows the extent to which learners agreed with 6 statements relating to their sense of belonging in school, including statements about how easily they get along with their peers, and whether they experience feelings of isolation or loneliness.

Most learners in Wales agreed or strongly agreed that they were liked by other learners (83%) which is statistically similar to the proportion of learners on average across OECD countries (82%). Around two-thirds of learners in Wales (63%) agreed or strongly agreed that they felt like they 'belong' at their school, which is also statistically similar to the average across OECD countries (75%). Similarly, a minority of learners in Wales and on average across OECD countries reported that they felt awkward and out of place in their school (29% and 21% respectively), like an outsider at school (20% and 17% respectively) or that they felt lonely at school (17% and 16% respectively).

Table 7.3: Proportion of learners in Wales and on average across OECD countries agreeing with statements about their sense of belonging at their school

Statement	Wales	OECD
I feel like an outsider (or left out of things) at school	20%	17%
I make friends easily at school	76%	76%
I feel like I belong at school	63%	75%
I feel awkward and out of place in my school	29%	21%
Other learners seem to like me	83%	82%
I feel lonely at school	17%	16%

Percentages based on the proportion of learners who agreed, or strongly agreed with the given statement. Wales data based on responses from between 1,785 and 1,834 learners (70% or 71% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST034

Learners in Wales who agreed or strongly agreed that they felt like they belonged at school had an average PISA mathematics score of 476, significantly higher than the average score of 454 for learners who either disagreed or strongly disagreed with the statement. On average across OECD countries learners who agreed or strongly agreed that they felt like they belonged at school had an average mathematics score 21 points higher than learners who disagreed or strongly disagreed. This was not significantly different from the gap in performance in Wales.

7.4.4 Learners' experiences of bullying at school

Learners were asked how often they had experienced different forms of bullying in the past 12 months at school. The proportion of learners in Wales reporting how often they experienced each of these is presented in Table 7.4. The table also shows the average proportion of learners across the OECD who reported experiencing each of these at least a few times a month.

The proportion of learners in Wales who reported never or almost never experiencing being threatened by other learners (79%), other learners spreading nasty rumours about

them (70%), or giving money to someone at school because they threatened them (98%) was similar to the proportion of learners on average across OECD countries (89%, 76% and 98% respectively). Similarly, the proportions of learners who reported never or almost never experiencing physical forms of bullying such as other learners taking away or destroying things that belonged to them (82%), getting hit or pushed around by other learners (78%), or being involved in a physical fight on school property (88%) were also statistically similar to the proportion of learners on average across OECD countries (86%, 88% and 91% respectively). However, a statistically significant smaller proportion of learners in Wales reported that other learners never or almost never made fun of them (51%) or left them out of things on purpose (65%) than on average across OECD countries (66% and 77% respectively).

In Wales, around a fifth of learners (20%) reported being made fun of at school at least a few times a month; this was statistically similar to the OECD average of 12% of learners. Additionally, a similar proportion of learners in Wales and across OECD countries reported frequent experiences of being left out of things on purpose, or being hit or pushed around by other learners.

Table 7.4: Proportion of learners in Wales and on average across OECD countries reporting different experiences of bullying at school

Statement	Never or almost never	A few times a year	A few times a month or more	A few times a month or more (OECD average)
Other learners left me out of things on purpose	65%	24%	10%	7%
Other learners made fun of me	51%	29%	20%	12%
I was threatened by other learners	79%	13%	8%	3%
Other learners took away or destroyed things that belonged to me	82%	12%	5%	3%
I got hit or pushed around by other learners	78%	15%	7%	4%
Other learners spread nasty rumours about me	70%	21%	9%	7%
I was in a physical fight on school property	88%	10%	2%	2%
I stayed at home from school because I felt unsafe	88%	8%	4%	4%
I gave money to someone at school because they threatened me	98%	1%	2%	1%

Wales data based on responses from 2,159 to 2172 learners (84% weighted learner response rate). OECD data based on responses from 36 OECD countries.
Because of rounding, some results may appear inconsistent.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST038

Across the OECD, including in Wales, learners who reported these happening regularly, particularly those reporting that these happened once a week or more, had lower average levels of PISA mathematics performance than those who reported less frequent instances of bullying. Across OECD countries, for a one-unit increase in the index of exposure to bullying there was a decrease on average of 8 score points in mathematics. In Wales the decrease was 4 score points.

7.4.5 Learners' sense of relative family wealth

Learners in Wales were asked about their perceptions of their relative family wealth compared to other families in the country. On a scale from 1 to 10, learners were told that people who earn the most money, receive the best education, and have the most respected jobs would be rated as a 10, whereas the least well-off families, who earn the

least money, receive no education, and have no or the least respected jobs would be rated a 1. Learners were asked to first rate where they would place their family on this scale, and then where they think they would end up on the scale at the age of 30.

Figure 7.3 shows that around 59% of learners placed their relative family wealth as a 7 or higher on the scale, and around 10% of learners in Wales placed their family wealth lower than a 5 on the scale now. This is similar to the proportion of learners on average across OECD countries[15] where 67% of learners placed their relative family wealth as a 7 or higher on the scale, and only around 8% placed their family wealth lower than a 5 on the scale now.

Learners had positive expectations for their future relative wealth, with just under a quarter (24%) expecting to rate as a 9 or 10 on the scale by the age of 30, compared to 15% of learners now. This is lower than the proportion of learners on average across OECD countries where 34% expect to rate as a 9 or 10 on the scale by the age of 30.

Learners' perceptions of their current relative family wealth were in general related to their performance in mathematics, with learners placing their relative family wealth lower on the scale achieving a lower average score in mathematics. This was true for all groups except the group that placed their relative family wealth at 9 or 10 on the scale which had an average mathematics score of 435 which is below the average score for all learners in Wales.

---

[15] Data not available for 9 of the 37 OECD countries

Figure 7.3: Learners' perceptions of their current relative family wealth, and expectations of their relative wealth by the time they are aged 30.
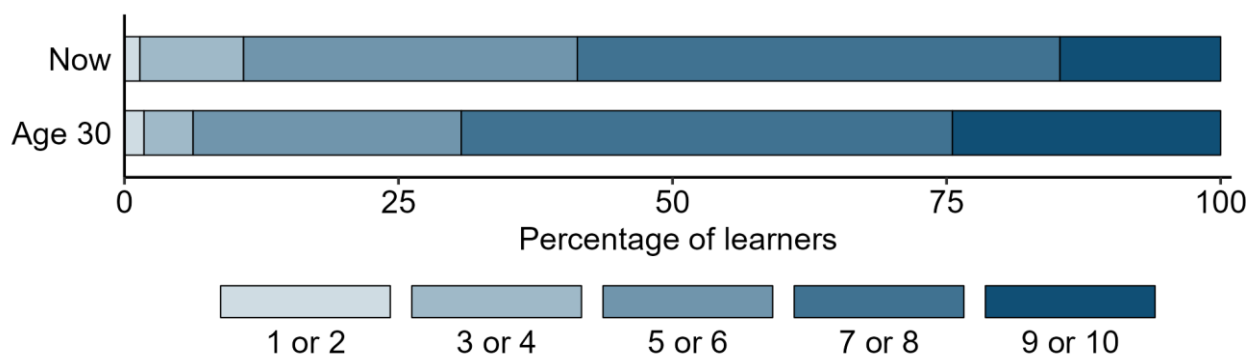
Time	1 or 2	3 or 4	5 or 6	7 or 8	9 or 10
Relative wealth now	1%	9%	30%	44%	15%
Expectation at age 30	2%	4%	24%	45%	24%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from 2,142 and 2,127 learners respectively (83% weighted response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST259

Learners were also asked about how often they did not eat in the past 30 days because there was not enough money to buy food. Table 7.5 shows the proportion of learners in Wales who reported that this had never or almost never happened in the past 30 days, compared to the proportion who reported that this happened every day or almost every day. Relative to the OECD average of 3% of learners, a statistically similar proportion of learners in Wales (6%) reported that they had to skip eating every day or almost every day because there was not enough money to buy food.

Table 7.5: Proportion of learners in Wales reporting different regularity of not being able to afford to buy food

Statement	Never or almost never	Between once a week and 5 times a week	Every day or almost every day
In the past 30 days, how often did you not eat because there was not enough money to buy food?	89%	5%	6%

Wales data based on responses from 2,187 learners (85% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST258

Learners in Wales who reported never or almost never not eating because there was not enough money to buy food had average PISA mathematics scores 63 points higher than learners in Wales who reported that they had to skip meals (475 compared to 411).

7.4.6 Learners' growth mindsets

In addition to more general questions about learners' wellbeing, the learner questionnaire also asks learners a variety of questions about their attitudes to learning, including whether they have views conducive to a 'growth mindset'.

A growth mindset refers to the view that intelligence is something that can be developed, rather than something static or predetermined. Dweck (2006; 2016) argues that learners who see intelligence as something that can be developed are more willing to embrace educational challenges, persevere when challenged, acknowledge and learn from criticism, and be inspired by others who succeed. In turn, Dweck argues that learners with a growth mindset are able to reach higher levels of achievement. By contrast, learners who see their intelligence as fixed are likely to avoid challenge and give up easily, ignore negative feedback and feel threatened by the success of others, and may therefore not reach their academic potential.

Four questions, shown in Table 7.6, asked learners about their views on statements relating to growth mindsets. In Wales, 43% of learners agreed or strongly agreed that intelligence could not be changed, while well over half of learners felt this way about creativity. Additionally, around 60% of learners agreed or strongly agreed that some people, regardless of how much they studied, would not be any good in mathematics, and a similar proportion responded this way about English/Welsh (depending on the medium of the school). These are similar to the proportion of learners on average in OECD countries where 65% of learners agreed or strongly agreed that some people, regardless of how much they studied, would not be any good in mathematics and 60% in English/Welsh.

Table 7.6: Proportion of learners in Wales agreeing with statements about the flexibility of intelligence and subject-specific skills

Statement	Wales	OECD
Your intelligence is something about you that you cannot change very much	43%	42%
Some people are just not good at mathematics, no matter how hard they study	60%	65%
Some people are just not good in English/Welsh*, no matter how hard they study	59%	60%
Your creativity is something about you that you cannot change very much	59%	53%

* Depending on language of test
Percentages based on the proportion of learners who agreed, or strongly agreed with the given statement. Wales data based on responses from between 2,079 and 2,090 learners (81% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST263

Learners in Wales who disagreed or strongly disagreed that your intelligence is something about you that you cannot change very much scored significantly higher on average in PISA mathematics than those who agreed or strongly agreed (490 and 448 respectively). Similarly on average across OECD countries, learners who disagreed or strongly disagreed that your intelligence is something about you that you cannot change very much also scored significantly higher on average in mathematics than those who agreed or strongly agreed, with an average difference of 24 score points. This was not significantly different from the average difference in Wales. Similarly, learners who disagreed or strongly disagreed that some people are just not good at mathematics or English/Welsh, no matter how hard they study scored significantly higher in mathematics than learners who agreed or strongly agreed, with a 29 score point difference for the statement that some people are just not good at mathematics, and a 20 score point difference for the statement that some people are just not good at English/Welsh. There was no significant difference in mathematics performance for learners in Wales who disagreed or strongly disagreed that your creativity is something about you that you cannot change very much compared to learners who agreed or strongly agreed.

7.4.7 Learner aspirations

Learners were asked which qualifications they expected to complete. The majority of learners in Wales expect to complete GCSEs as shown in Table 7.7. The proportion of learners who expected to complete A levels (65%) was lower than the average across OECD countries (78%). The proportion of learners who expected to complete a university degree or equivalent (53%) in Wales was similar to the OECD average.

Table 7.7: Proportion of learners in Wales who expect to complete specific qualifications

Statement	Yes	No	I don't know
GCSEs or equivalent (e.g. BTEC First)	87%	4%	9%
AS or A levels, or equivalent qualifications (e.g. BTEC National)	65%	12%	23%
A university degree (e.g. BA, BSc, BEd)	53%	15%	32%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from between 1,734 and 1,834 learners (67% to 71% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST327

7.5 Learner experiences of teaching and learning

This section reports on learners' responses to questions about their experiences of teaching and learning in mathematics, English (or Welsh in a Welsh medium school) and science, and compares these to those of learners on average in the OECD countries.

7.5.1 Learner attitudes towards mathematics, English or Welsh, and science

Almost all learners in Wales reported that they wanted to do well in mathematics, English or Welsh and science, though the majority of learners did not consider these subjects to be one of their favourites. Around half of the learners in Wales reported finding mathematics, English or Welsh, and Science easy which was similar to the proportion of learners on average across OECD countries. A similar proportion of learners in Wales wanted to do well in each of mathematics, science and English or Welsh as on average across OECD countries.

Table 7.8 shows the proportions of learners agreeing or strongly agreeing with each of the statements from Wales and OECD countries.

Table 7.8: Proportion of learners in Wales and on average across OECD countries agreeing with statements on their attitudes towards core subjects

Statement	Wales	OECD
Mathematics is one of my favourite subjects.	39%	39%
English/Welsh is one of my favourite subjects*.	40%	39%
Science is one of my favourite subjects.	45%	47%
Mathematics is easy for me.	46%	44%
English/Welsh is easy for me*.	54%	57%
Science is easy for me.	45%	50%
I want to do well in my mathematics class.	92%	89%
I want to do well in my English/Welsh class*.	92%	89%
I want to do well in my science class.	91%	88%

* Internationally, this question asked about the language of the test taken by the learner, not always English
Percentages based on the proportion of learners who agreed, or strongly agreed with the given statement.
Wales data based on responses from between 2,072 and 2,114 learners (81% or 82%weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST268

Learners in Wales were also asked to rate the quality of mathematics instruction this year on a scale of 1 to 10 where 1 was the worst mathematics instruction possible and 10 was the best mathematics instruction possible. In Wales, the average rating was 6.8 which was not significantly different from the OECD average of 6.4. Figure 7.4 shows the distribution of responses for learners in Wales and in the OECD.

Figure 7.4: Learners' perceptions of the quality of mathematics instruction in Wales and on average across OECD countries
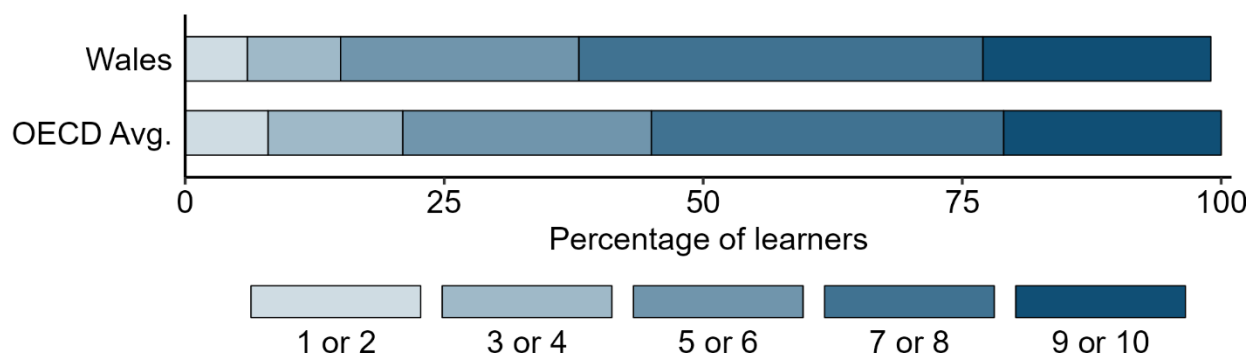
Education system	1 or 2	3 or 4	5 or 6	7 or 8	9 or 10
Wales	6%	9%	23%	39%	22%
OECD	8%	13%	24%	34%	21%

Percentages based on the proportion of learners who agreed, or strongly agreed with the given statement. Because of rounding, some results may appear inconsistent.
Wales data based on responses from 2,135 learners (83% weighted response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Learners were also asked how often their teacher supports them in their mathematics lessons by stating how often each of the activities in Table 7.9 occurred. The proportion of learners who reported that each of the support activities occurred in every or most mathematics lessons was similar to the average proportion of learners OECD who reported this in countries. The majority of learners in Wales reported that their mathematics teacher gives extra help when needed in every or most mathematics lessons (77%) and that their mathematics teacher helps learners with their learning in every or most lessons (79%), again similar to the proportion reported by learners on average across OECD countries (70% and 72% respectively). Learners in Wales also reported that their mathematics teacher 'shows an interest in every learner's learning' in every or most mathematics lesson (68%), and 'continues teaching until the learners understand' in every or most mathematics lesson (71%). These percentages are similar to those on average across OECD countries (63% and 64% respectively).

Table 7.9: Proportion of learners in Wales and on average across OECD countries who reported that each of these statements occurred in every or most mathematics lessons

Statement	Wales	OECD
The teacher shows an interest in every learner's learning.	68%	63%
The teacher gives extra help when learners need it.	77%	70%
The teacher helps learners with their learning.	79%	72%
The teacher continues teaching until the learners understand.	71%	64%

Percentages based on the proportion of learners who said the given statement happens in 'every' or in 'most' of their mathematics lessons.
Wales data based on responses from between 2,075 and 2,077 learners (81% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST270

7.5.2   Learner time spent on learning-related activities

Learners in Wales on average reported spending a similar amount of time each day on mathematics, English or Welsh, and science homework with around 60% of learners reporting spending up to 30 more minutes each day on each of these subjects, as shown in Table 7.10. The majority of learners (55%) reported spending less than 1 hour each day on homework which is similar to the proportion on average across OECD countries (46%).

Table 7.10: Time spent on homework as reported by learners in Wales

Statement	Up to 30 minutes a day	More than 30 minutes and up to 1 hour a day	More than 1 hour a day
Mathematics homework	63%	23%	15%
English/Welsh homework*	61%	24%	15%
Science homework	58%	26%	17%
Total time for all homework in all subjects, including subjects not listed above	36%	19%	45%

* Depending on the language of the test
Wales data based on responses from between 2,020 and 2,042 learners (79% or 80% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST296

There were no significant differences in the mathematics performance of learners in Wales who reported spending less than 30 minutes a day (471), those who reported spending between 30 minutes and 1 hour (477), and those who spent more than 1 hour a day on mathematics homework (470). Similarly, there were no significant differences in the reading performance of learners in Wales who reported spending less than 30 minutes a day (471), those who reported spending between 30 minutes and 1 hour (481), and those who spent more than 1 hour a day (476) on English or Welsh. The science performance of learners who reported spending between 30 minutes and 1 hour a day on science homework was significantly higher than learners who reported spending less than 30 minutes a day, (499 and 469 respectively).

For the total time for all homework in all subjects, learners in Wales who reported spending more than 30 minutes and up to 1 hour a day had an average mathematics score of 488, which was similar to the performance of learners who reported spending more than 1 hour a day in total (486), and significantly higher than learners who reported spending up to 30 minutes a day (449).

Learners in Wales were also asked about additional mathematics learning activities that they participated in. Learners in Wales participated in the range of activities to a similar extent as the average in OECD countries. Half of the learners in OECD countries did not take part in any additional mathematics learning activities, which is similar to the 44% of learners in Wales who reported that they did not take part in any of these activities. Learners' reported participation in these different additional mathematics learning activities are shown in Table 7.11.

Table 7.11: Proportion of learners in Wales and on average across OECD countries who reported attending additional mathematics learning activities this school year

Statement	Wales	OECD
One-on-one tutoring with a person	17%	20%
Internet or computer tutoring with a programme or application	18%	18%
Video-recorded instruction by a person	15%	16%
Small group study or practice (2 to 7 learners)	17%	18%
Large group study or practice (8 or more learners)	13%	10%
I do not participate in additional mathematics learning activities	44%	50%

Wales data based on responses from 2,193 learners (85% weighted learner response rate). Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST297

7.5.3 Learner use of digital devices

Learners in Wales were asked how many hours a day they usually used digital resources in a range of different situations in the last school year. Table 7.12 shows that less than a half of learners in Wales reported using digital resources for more than an hour a day for learning activities in school (49%), before and after school (38%) and at weekends (42%).

Table 7.12: Time learners in Wales reported using digital resources for learning activities.

Statement	None	Up to 1 hour	More than 1 hour
For learning activities at school	14%	37%	49%
For learning activities before and after school	30%	32%	38%
For learning activities on weekends	34%	24%	42%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from between 2,034 and 2,100 learners (79% to 82% weighted learner response rate)
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 ST326

A large proportion of learners in Wales reported not using digital resources for leisure activities in school or using them for less than an hour a day (70%). The majority of learners in Wales reported using digital resources for more than 4 hours for leisure on weekends (63%), as shown in Table 7.13. Around a third of learners in Wales reported that they did not use digital devices for leisure at school (29%) which is similar to the OECD average of 30%.).

Table 7.13: Time learners in Wales reported using digital resources for leisure activities.

Statement	None or up to 1 hour	More than 1 hour and up to 4 hours	More than 4 hours
For leisure at school	70%	25%	5%
For leisure before and after school	29%	38%	34%
For leisure on weekends	13%	24%	63%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from between 2,041 and 2,050 learners (79% or 80% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD' PISA 2022 ST326

Learners were asked how often they used different digital devices or software at school and at home. Most learners in Wales accessed the Internet in school at least once a week (80%) and also used a desktop or laptop computer at least once a week (84%), as shown in Table 7.14. Educational software and school learning platforms were used less often, with 48% of learners reporting that they used educational software, games or apps, or other learning tools and 33% of learners using a learning management system or school learning platform only once or twice a month or less often.

Table 7.14: How often learners in Wales who reported using digital devices or software in school

Statement	Once or twice a month or less often	About once or twice a week	Every day or several times a day
Desktop or laptop computer	15%	44%	40%
Smartphone (i.e. mobile phone with internet access)	32%	15%	47%
Tablet device (e.g. iPad, Galaxy Tab, Amazon Fire) or e-book reader (e.g. Amazon Kindle, Kobo)	64%	13%	15%
Internet access (except on smartphones)	17%	28%	52%
School portal (to consult timetable, absences, etc.)	50%	15%	29%
Educational software, games or apps, other learning tools (e.g. CK-12™ or Mathalicious online support)	48%	23%	24%
A learning management system or school learning platform (e.g. Blackboard, Edmodo, Moodle, Google Classroom)	33%	24%	39%

Table does not include learners who reported that the resource was not available to them in school.
Wales data based on responses from between 2,049 and 2,129 learners (80% to 83% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 IC170

Out of school, the majority of learners in Wales reported using a smartphone (82%) and a desktop or laptop computer (53%) every day or several times a day. The majority of learners (75%) also reported accessing the Internet on a device other than a smartphone every day or several times a day. Around a quarter of learners in Wales (25%) reported using educational software, games, Apps, or other learning tools every day or several times a day out of school and around half (53%) reported playing video or online games every day or several times a day. Table 7.15 shows how often learners in Wales reported using different digital devices or software out of school.

Table 7.15: How often learners in Wales reported using digital devices or software out of school

Statement	Once or twice a month or less often	About once or twice a week	Every day or several times a day
Desktop or laptop computer	21%	24%	53%
Smartphone (i.e. mobile phone with Internet access)	9%	7%	82%
Tablet device (e.g.iPad, Galaxy Tab,) or e-book reader (e.g., Amazon Kindle, Kobo)	46%	17%	33%
Internet access (except on smartphones)	10%	13%	75%
Educational software, games or Apps, other learning tools (e.g. CK-12™ or Mathalicious online support)	52%	19%	25%
Video or online games (e.g. used with game consoles such as a Play Station 4® or Nintendo Wii®, online gaming platforms such as Steam® or gaming Apps such as Angry Birds®)	27%	17%	53%

Table does not include learners who reported that the resource was not available to them out of school. Wales data based on responses from between 2,007 and 2,029 learners (78% or 79% weighted learner response rate).

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 IC171

A similar proportion of learners in Wales reported that a range of digital resources were available and used in school to the proportion of learners on average across OECD countries, as shown in Table 7.16.

Table 7.16: Proportion of learners in Wales and on average across OECD countries agreeing with statements about the availability and use of digital resources in school

Statement	Wales	OECD
There are enough digital resources for every learner at my school.	69%	71%
There are enough digital devices with access to the Internet at my school.	76%	74%
The school's Internet speed is sufficient.	53%	54%
Digital resources function properly at my school.	68%	71%
Digital resources are easily accessible within the classroom.	70%	67%
Digital learning resources available at my school make learning interesting.	73%	68%
The school provides sufficient technical support to help learners in their use of digital resources.	74%	69%
Teachers at my school have the necessary skills to use digital devices during instruction.	71%	70%
Teachers at my school are willing to use digital resources for teaching.	80%	77%

Wales data based on responses from between 1,994 and 2,046 learners (78% to 80% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 IC172

In Wales, the majority of learners reported that they used digital resources in less than half of their mathematics (70%), English or Welsh (68%), and science (64%) lessons. Around one-sixth of learners in Wales reported using digital resources in more than half their lessons or every lesson (17% in English or Welsh lessons, 17% in mathematics lessons and 19% in science lessons).

Table 7.17: How often learners in Wales reported using digital resources in lessons

Statement	Less than half of the lessons or never	In about half of the lessons	In more than half of the lessons or every lesson
English or Welsh	68%	14%	17%
Mathematics	70%	12%	17%
Science	64%	17%	19%

Wales data based on responses from between 2,015 and 2,056 learners (78% or 80% weighted learner response rate).

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022 IC173

8 Schools

8.1 Chapter overview

This chapter focuses on the responses from headteachers of learners that participated in PISA 2022 to the school questionnaire. It discusses school management and policies, as well as aspects related to school climate. A description of variation in mathematics performance both within and across schools in Wales is also provided.

8.2 Key findings

- In terms of school admission, 76% of learners in Wales were in schools where the residential area of the learner was reported to be a factor in their admission. Whether the learner is a family member of a current or former learner was reported as influencing school admissions for 46% of learners.

- A larger percentage of learners were in schools where headteachers in Wales reported the use of teacher monitoring and evaluation approaches when compared to the OECD averages. These included tests or assessments of learner achievement, teacher peer review, and observations of lessons.

- A larger percentage of learners were in schools where headteachers in Wales also reported the use of teacher training development activities and workshops when compared to the OECD averages.

8.3 School questionnaire

As part of PISA 2022, headteachers of participating schools were asked to complete a questionnaire. This questionnaire asked about aspects related to school context, school management, teaching staff, assessment and evaluation, grouping policies in school, the school climate and learning environment.

A number of questions in the school questionnaire related to policy and practices at the school and asked headteachers to state whether the policies are mandatory as well as how frequently they are practised in their school (e.g., weekly, monthly, never). Some questions also ask headteachers to elaborate on details regarding each policy or practice, as well as their perceptions of the impact of certain policies at their school. As in the previous chapter, this chapter describes the questions that headteachers were asked, the possible response options for each question, and their responses to relevant sub-questions. As PISA is a study of learners in schools and not schools directly, the results are reported in terms of the percentage of learners in schools, with each headteacher representing a certain proportion of those learners with their responses. In order to ensure that the answers from these headteachers remain confidential and anonymous some figures are suppressed, such as responses where fewer than 10 learners are

represented by the figures. The results for Wales are presented and compared with averages across OECD countries to provide a perspective on how these factors in schools in Wales align with those on average in other education systems.

It is important to note that not all headteachers completed the school questionnaire and among those that did, individual questions had differing response rates. Additionally, the sample of schools in Wales participating in PISA in 2022 did not meet some of the PISA sampling standards (see Chapter 1 for further details). Consequently, the national results reported in this chapter should be interpreted with caution and a note is included below each table that shows the number of schools that responded to each item or set of items and the weighted earner response rate. In order to provide information that presents the most reliable information available, this chapter only includes questions that had weighted response rates from headteachers in Wales of at least 60% for the majority of items within a question (i.e., a minimum of 54 schools).

8.4   School management and policies

This section presents the responses of headteachers to questions regarding school type, characteristics of learners who attend their schools, and policies regarding admissions, monitoring and evaluation and professional development at their school. The findings are presented in terms of the percentage of learners that are represented by the responses of their headteacher.

8.4.1   School characteristics

Headteachers of participating learners were asked whether their school was public (i.e., managed directly or indirectly by a local authority, government agency, or central government) or independent (i.e., managed directly or indirectly by a non-government organisation). Almost all learners in Wales were in schools (over 97%) identified as a public school by their headteacher compared to an average of 83% of learners in schools across OECD countries.

Headteachers of participating learners were also asked about the overall characteristics of Year 10 and 11 learners in their schools. On average headteachers reported that the proportion of learners in their schools from socioeconomically disadvantaged homes was 25% or who are refugees (< 2%) was similar to the OECD average (22% and 1% respectively). These results are shown in Table 8.1. The proportion of learners with special educational needs (17%) was higher than the OECD average (11% respectively).

Table 8.1: Percentage of Year 10 and Year 11 learners in schools in Wales and schools on average in OECD countries with particular characteristics

Criteria	Wales	OECD
Learners with special educational needs	17%	11%
Learners from socioeconomically disadvantaged homes	25%	22%
Learners who are immigrants (not including refugees)	2%	8%
Learners who have parents who have immigrated	5%	12%
Learners who are refugees	< 2%	1%

Wales data based on responses from between 1,853 and 1,985 learners in between 63 and 68 schools (71% to 76% weighted learner response rate).

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022, SC211

8.4.2 School admissions policies

PISA 2022 asked headteachers about their school's admissions criteria and their frequency of use. Different criteria used by schools and differences in their frequency of use can lead to greater between school variation in mathematics performance (see Section 8.5 for a discussion on between-school variation). In Wales, some of these admissions criteria are required by local authorities. The responses from headteachers in Wales describing the frequency at which each of the factors considered for admission to their school are shown in Table 8.2.

Learners in Wales were in schools with headteachers who reported that residence in a particular area was one of the factors most frequently used for selection. The majority of learners were in schools where headteachers reported their school either sometimes or always considers residential area for admissions (76%). On average across OECD countries 60% of learners were in schools where headteachers reported using the residential area for admissions.

Table 8.2: Factors considered sometimes or always for admission to school as reported by headteachers in Wales and on average across OECD countries

Criteria	Wales	OECD
Learner's record of academic performance	16%	52%
Recommendation of feeder schools	28%	41%
Parents' or guardians' endorsement of the teaching or religious philosophy of the school	14%	26%
Whether the learner requires or is interested in a special programme	31%	57%
Preference given to family members of current or former learners	46%	40%
Residence in a particular area	76%	60%
Learner's disciplinary record in this or another school	41%	45%
Learner's parental status or pregnancy	9%	10%
Learner's working status	9%	14%
Learner's cultural or ethnic background	6%	9%

Proportion of learners with headteachers who reported sometimes or always using each admission criteria Wales data based on responses from 1,722 learners in 59 schools (66% weighted learner response rate). Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022, SC012

The learner's academic record was considered for admissions for fewer than 16% of learners in Wales where headteachers said this criterion was used either sometimes or always. Across OECD countries, 52% of learners were in schools where headteachers reported that learners' academic records were sometimes or always considered. Criteria related to learners' personal characteristics such as their cultural or ethnic background, their working status or their parental status were rarely considered as admission criteria in Wales or in other OECD countries.

8.4.3 Monitoring and evaluation

Headteachers in participating schools reported on the procedures, policies and practices associated with quality assurance and school improvements at their schools. They were asked to describe the quality assurance practices listed in Table 8.3 according to whether they exist at their school as well as whether the existing arrangements were based on mandatory national or local policies or school initiatives.

The most frequent quality assurance and school improvement activities reported by headteachers in Wales are shown in Table 8.3. The majority of learners in schools in Wales and on average across OECD countries were in schools where headteachers reported that they used each of these quality assurance and school improvement activities. Learners in Wales were more likely to be in schools where headteachers

reported using regular consultation aimed at school improvement with one or more experts over a period of at least six months (over 98% of schools) than on average across OECD countries (53% of schools).

Table 8.3: Quality assurance and school improvement activities used as reported by headteachers in Wales and on average across OECD countries

Quality assurance and school improvement activities	Wales	OECD
Internal evaluation / Self-evaluation	>98%	95%
External evaluation	>98%	78%
Written specification of the school's curricular profile and educational goals	>98%	92%
Written specification of learner performance standards	>98%	86%
Systematic recording of data such as teacher or learner attendance and professional development	>98%	95%
Systematic recording of learner test results and graduation rates	>98%	95%
Seeking written feedback from learners	89%	71%
Teacher mentoring	97%	81%
Regular consultation aimed at school improvement with one or more experts over a period of at least six months	98%	53%
Implementation of a standardised policy for mathematics subjects	94%	67%

Percentages are the proportions of learners with headteachers reporting that these activities were used either because they were mandatory or on the school's initiative
Wales data based on responses from between 1,635 and 1,664 learners in 56 or 57 schools (63% to 64% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022, SC037

Headteachers were also asked to state which approaches to monitoring teachers were used at their school in the last school year. The percentage of learners in schools reported to be using each approach in Wales and on average across OECD countries are presented in Table 8.4.

Table 8.4: Approaches to monitoring teachers at school as reported by headteachers in Wales and on average in OECD countries

Approach to monitoring teachers	Wales	OECD
Tests or assessments of learner achievement	82%	73%
Teacher peer review (of lesson plans, assessment instruments, lessons)	88%	58%
Headteacher or senior staff observations of lessons	95%	77%
Observation of classes by inspectors or other persons external to the school	67%	33%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from 1,669 learners in 57 schools (64% weighted learner response rate). Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022, SC032

All four of the presented options were more commonly used in Wales than across OECD countries. Lesson observations by the headteacher or senior staff members was the most commonly used approach, with 95% of learners in Wales and 77% of learners across all OECD countries being in schools where headteachers reported using it in the last year to monitor teachers. Lesson observations by external inspectors were less commonly reported in Wales (67%) and only 33% of learners were in schools where headteachers reported this on average across OECD countries.

Headteachers were also asked about the impact of teacher appraisals within their school and Table 8.5 presents details of their responses. The majority of learners were in schools where headteachers reported that teacher appraisals had small or no impact on salary (83%) or financial rewards (92%) in Wales. In contrast, 89% of learners were in schools where headteachers reported that teacher appraisals had moderate or large impact on opportunities for professional development.

Table 8.5: Impact of teacher appraisals at school as reported by headteachers in Wales

Type of impact	Small or no impact	Moderate or large impact
A change in salary	83%	17%
A financial bonus or another kind of monetary reward	92%	8%
Opportunities for professional development activities	11%	89%
A change in the likelihood of career advancement	47%	53%
Public recognition from you	49%	51%
Changes in work responsibilities that make the job more attractive	70%	30%
A role in school development initiatives	28%	72%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from 1,636 learners in 56 schools (62% weighted learner response rate). Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022, SC193

8.4.4   Teacher professional development

Headteachers were asked to report the percentage of teachers at their school who had attended a formal programme of professional development in the three months before the study took place in autumn 2022. To qualify as a programme of professional development for this item, the session needed to be designed to enhance teaching skills or pedagogical practice, focused on teaching and education, and have lasted for at least one full day. It was not necessary for the professional development activities to lead to a recognised qualification.

In Wales, an average of 82% of teaching staff at learners' schools had attended recent professional development sessions as reported by headteachers. This is substantially higher than the average across OECD countries, of 51% of teachers.

Headteachers were also asked to state the percentage of mathematics teachers who had recently attended professional development. In Wales and on average across OECD countries, the average proportion of mathematics teachers who were reported to have attended recent professional development was very similar to the averages reported for all teachers (79% and. 48% respectively).

Headteachers also described the in-house professional development activities that took place at their schools. Table 8.6 shows the percentage of learners in schools with headteachers who reported that their school organised in-house professional

development activities in the form of specialist training sessions, workshops for specific school issues, and/or workshops for specific groups of teachers.

Table 8.6: Type of in-house professional development activities as reported by headteachers in Wales

Type of professional development activity	Wales	OECD
Our school invites specialists to conduct in-service training for teachers	97%	80%
Our school organises in-service workshops which deal with specific issues that our school faces	> 98%	84%
Our school organises in-service workshops for specific groups of teachers	> 98%	72%

Because of rounding, some results may appear inconsistent.
Wales data based on responses from 1,654 learners in 57 schools (64% weighted learner response rate).
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022, SC027

The majority of learners in Wales were in schools where headteachers reported that each of the professional development activities was organised in their school, over 97% of headteachers in each case. On average across the OECD 84% of learners were in schools where headteachers reported organising workshops focusing on specific issues that their school faced, 80% reported inviting specialists to conduct training, and 72% organised workshops for specific groups of teachers.

8.5 School-level variation in mathematics performance

PISA provides information about the extent to which mathematics performance varies across different schools, as well as how much it varies within each of the participating schools. School level variation in mathematics performance can provide insight into the level of heterogeneity at and across schools. On average across OECD countries, 32% of the total variance in mathematics performance in PISA 2022 was attributed to differences between schools, while the remaining 68% of the variance was attributed to differences within schools. In Wales, 12% of the total variance in mathematics performance was between schools, which is smaller than the OECD average, with the remaining 88% attributed to differences within schools. This suggests there is slightly less heterogeneity between schools in Wales compared to other OECD systems.

The potential factors that contribute towards between/within school variance are widespread and often difficult to disentangle. Further research controlling for factors such as learner background, school type, and classroom practices may provide insight into the different factors affecting attainment gaps in mathematics performance in Wales both within and across schools. The results for Wales in PISA 2022 reinforce the need for

interventions aimed at reducing attainment gaps to focus on disparities within schools, not only at the school level.

9 PISA across the United Kingdom

9.1 Chapter overview

This chapter compares the PISA mathematics, reading and science scores for Wales, England, Northern Ireland, and Scotland. The analysis includes a comparison of how each nation scores across the mathematics sub-domains described in Chapter 3. This chapter also compares the relative performance of the highest and lowest achieving learners in each UK nation, the relative gender differences in their average scores, and the relative differences between the most and least disadvantaged socioeconomic groups.

9.2 Key findings

- All UK countries have lower average scores for mathematics and reading relative to their performance in 2018. The differences between the 2018 and 2022 average scores were statistically significant in both cases.

- The average mathematics score for Wales (466) was significantly different to the average scores for Northern Ireland (475) and England (492), but not significantly different to the average scores for Scotland (471).

- The rank order of UK nations is broadly consistent across the different mathematics sub-domains, suggesting that individual nations do not have relative strengths or weaknesses (relative to each other) in terms of the different areas of mathematics that were assessed in PISA 2022.

- The average reading score for Wales (466) was significantly different to the average scores for Northern Ireland (485), Scotland (493) and England (496).

- The average science score for Wales (473) was significantly different to the average scores for Scotland (483), Northern Ireland (488) and England (503).

- Gender differences in PISA 2022 were consistent across the nations of the UK, with boys having a significantly higher average score for mathematics and girls having a significantly higher average score for reading. In science there were no significant gender differences in any nation of the UK.

- Learners from relatively less disadvantaged socioeconomic backgrounds performed significantly better than those from relatively more disadvantaged backgrounds across all domains and all UK nations.

9.3 Introduction

The focus of this chapter is the comparison of PISA scores for Wales, England, Northern Ireland and Scotland. Although the OECD reports on the United Kingdom (UK) as a

single participating country, schools and learners from each of the constituent nations are sampled separately. This means that each UK nation has a representative sample, allowing reasonably robust comparisons between their scores to be made.

Though there are many similarities between Wales, England, Northern Ireland and Scotland, there are also substantive differences in terms of their education systems, culture, and demographic composition. This report does not attempt to explore possible explanations for the differing scores between the UK nations.

To this end, this chapter summarises and compares the scores for UK nations across the three domains of mathematics, reading and science. The chapter also compares performance across the mathematics sub-domains, thus providing insight into the relative strengths and weaknesses of each nation in terms of their performance in mathematics. The relative performance of high and low achieving learners is also compared across nations, as are relative differences in performance across socioeconomic groups and by gender.

As has been noted throughout the previous chapters, the school-level and learner-level response rates for Wales did not meet some of the PISA sampling standards (as was the case with the other UK nations), and so caution is required when interpreting the analysis reported here. Please see Chapter 1 for more information about how to interpret the findings of this report, but it is worth reiterating that, for Wales, the non-response bias analysis indicated that the potential bias in the findings was somewhat mitigated through the use of statistical weightings.

9.4   Comparing average scores across the UK

Figure 9.1 shows the average PISA scores for each nation in each of the three domains. It is important to note that not all differences between nations were statistically significant. The rank order of UK nations should therefore be interpreted with caution. Please see Appendices B-D for detailed statistical comparisons between the nations. This section focuses on statistically significant differences between the average scores in Wales and the other UK nations.

For mathematics, the average score for learners in Wales was 466. The difference between this average score and that for England (492) was statistically significant, as was the difference between the average scores in Wales and Northern Ireland (475). The difference between the average scores in Wales and Scotland (471) does not reach the threshold for statistical significance.

For reading, the difference between the average score for Wales (466) and England (496) was statistically significant, as are the differences between Wales and Northern Ireland (485) and Wales and Scotland (493).

A similar patten is observed for science. The average learner score for science in Wales was 473. The differences between this and the other UK nations are all statistically significant, with England having an average score of 503, Northern Ireland an average score of 488, and Scotland an average score of 483.

Figure 9.1: Average PISA domain scores by nation
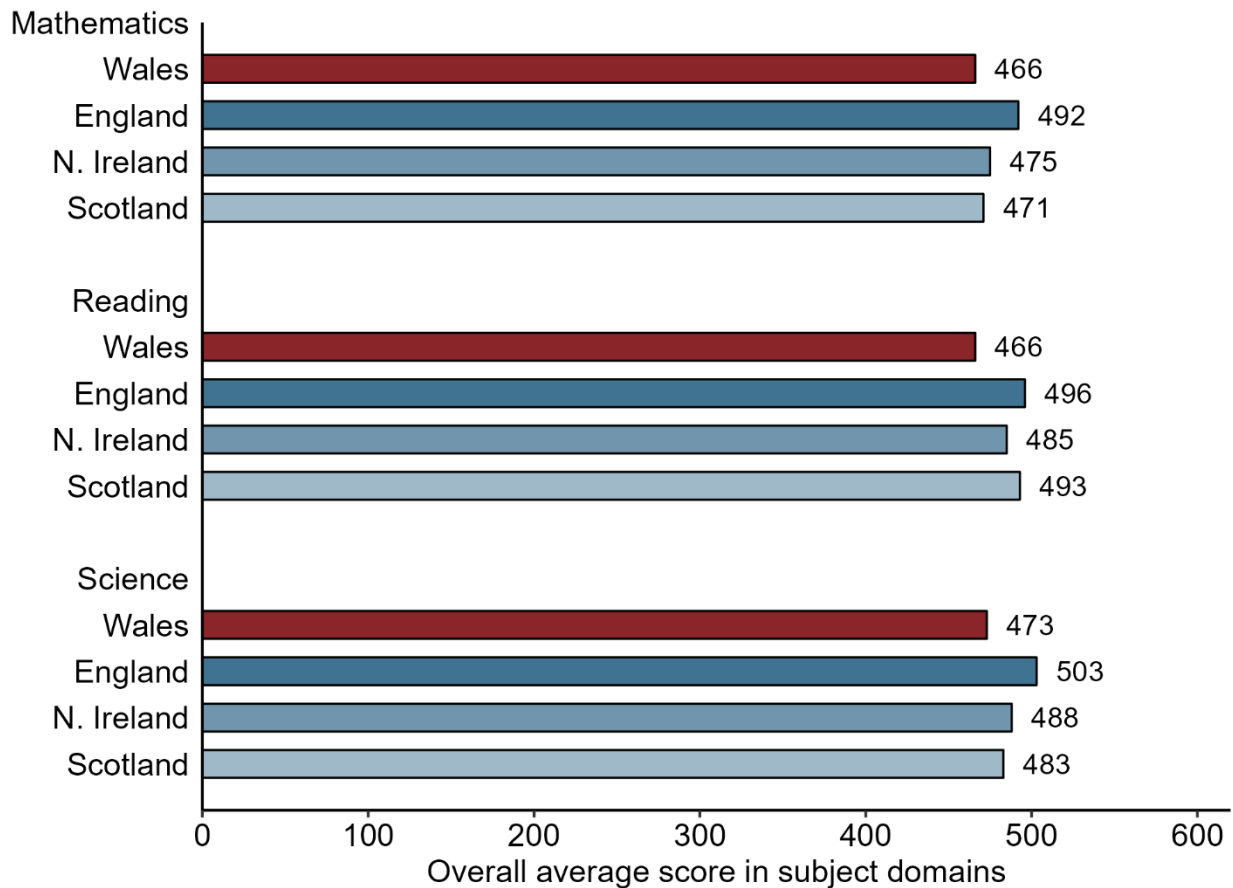
Nation	Mathematics	Reading	Science
Wales	466	466	473
England	*492	*496	*503
Northern Ireland	*475	*485	*488
Scotland	471	*493	*483

Base: All participating learners.
An asterisk (*) indicates where a nation's score was significantly different to the equivalent score for Wales.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

The scores for mathematics can be broken down into the 8 subdomains that are described in Chapter 3. Table 9.1 provides a summary of how each nation performed in each of these subdomains. As with the overall average scores, it is important to note that not all differences between nations in subdomains were statistically significant. The rank order of UK nations should be interpreted cautiously. Please see Appendices B to D for

detailed statistical comparisons between the nations. Here, we focus on comparing Wales to the other UK nations.

The differences between the subdomain specific average scores for Wales and England were statistically significant in all cases. The differences between the average scores for Wales and Northern Ireland were statistically significant for two subdomains: 'Quantity' and 'Interpreting, applying and evaluating mathematical outcomes'. Finally, when comparing Wales with Scotland, only the difference between average scores for the 'Quantity' subdomain was statistically significant.

Table 9.1: Average PISA mathematics subdomain score by nation

Mathematics subdomain	Wales	England	Northern Ireland	Scotland
Change and relationships	465	*491	475	464
Quantity	462	*491	*478	*474
Space and shape	451	*480	461	461
Uncertainty and data	475	*502	482	476
Employing mathematical concepts, facts and procedures	464	*492	476	465
Formulating situations mathematically	461	*488	471	462
Interpreting, applying and evaluating mathematical outcomes	467	*495	*479	477
Mathematical reasoning	467	*493	474	477

Base: All participating learners.
An asterisk (*) indicates where a subdomain score for a nation was significantly different to the equivalent score for Wales.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Wales has the lowest average scores for nearly all of the subdomains. The disparity between the highest and lowest scoring nations was similar across the subdomains. This suggests that the differences between the nations in overall performance do not reflect disparities for specific subdomains but rather a consistent difference across all of them. In other words, though there are differences in how the nations performed in mathematics overall, these do not appear to stem from differences in particular subdomains.

9.5   Performance across the PISA proficiency levels

The UK nations may also be compared in terms of the percentages of learners attaining at each of the PISA proficiency levels for mathematics, reading and science. These

proficiency levels range between 1 and 6, with Level 1 further divided into Levels 1a, 1b and 1c for mathematics and Levels 1a and 1b for reading and science. Each level is defined by a band of scores into which a learner's score may fall (a score may also fall below the threshold for Level 1). In the following sections the UK nations are compared with regard to their proportion of top performing learners (those learners attaining Level 5 or Level 6) and low performing learners (those learners attaining below Level 2). As a reminder, the term significant is used to refer to a statistically significant difference between Wales and another UK nation.

9.5.1 Mathematics

Figure 9.2 shows the percentage of learners attaining at each PISA mathematics proficiency level in each nation of the UK. For Wales, 32% of learners were low performing, attaining below Level 2. This was not significantly different to either Scotland (31%) or Northern Ireland (28%), though the proportion of low-performing learners in England (23%) was significantly lower. Six per cent of learners in Wales were high performing, attaining at Level 5 or 6, significantly below England (12%) but not significantly different to either Northern Ireland (8%) or Scotland (8%). In general, the proportions of learners at each level reflect the differences in the overall average PISA mathematics score that are discussed above.

Figure 9.2: Percentage of learners achieving each mathematics proficiency level by UK nation
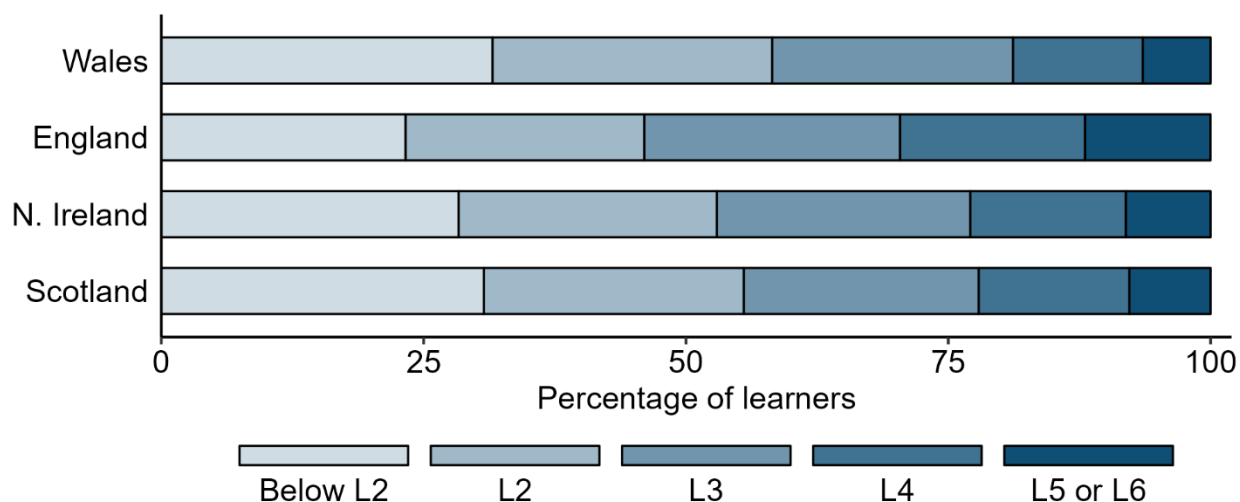
Nation	Below L2	L2	L3	L4	L5 or L6
Wales	32%	27%	23%	12%	6%
England	*23%	*23%	24%	*18%	*12%
Northern Ireland	28%	25%	24%	15%	8%
Scotland	31%	25%	22%	14%	8%

Base: All participating learners.
An asterisk (*) indicates where a percentage was significantly different to the equivalent percentage for Wales. Percentages may appear inconsistent due to rounding.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

9.5.2 Reading

Figure 9.3 shows the percentage of learners attaining at each PISA reading proficiency level in each nation of the UK. In Wales 29% of learners were low performing, attaining below Level 2, which was significantly higher than the proportions of low performing learners in each of Northern Ireland (22%), England (20%) or Scotland (20%).

Five per cent of learners in Wales were top performing, attaining at Level 5 or 6, significantly below England (10%), Scotland (10%) and Northern Ireland (8%). As with mathematics, this broadly reflects the differences between each nation's overall average reading score.

Figure 9.3: Percentage of learners achieving each reading proficiency level by UK nation
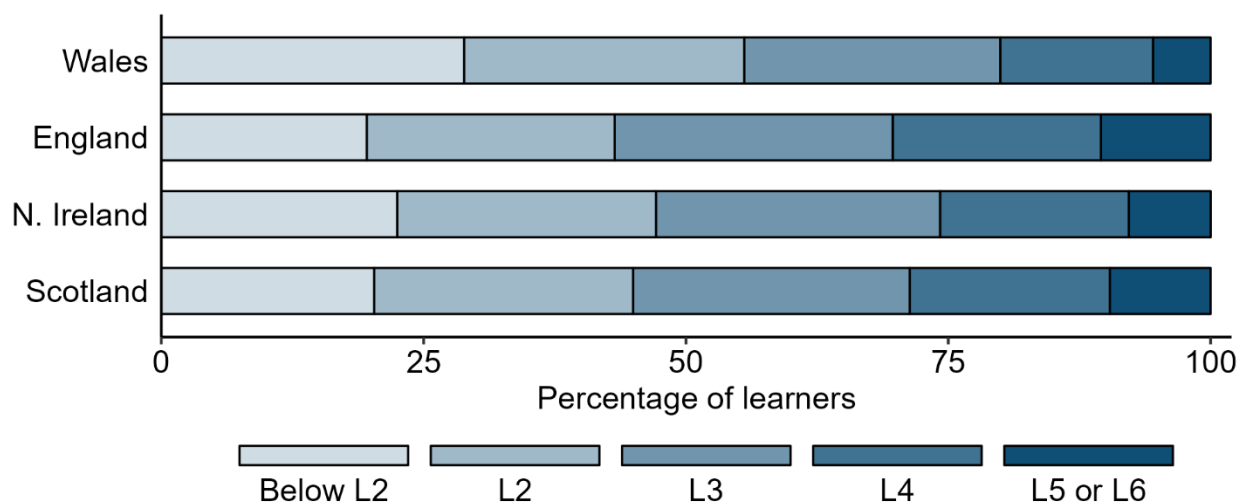
Nation	Below L2	L2	L3	L4	L5 or L6
Wales	29%	27%	24%	15%	5%
England	*20%	*24%	26%	*20%	*10%
Northern Ireland	*22%	25%	27%	*18%	*8%
Scotland	*20%	25%	26%	*19%	*10%

Base: All participating learners.
An asterisk (*) indicates where a percentage was significantly different to the equivalent percentage for Wales. Percentages may appear inconsistent due to rounding.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

9.5.3 Science

Figure 9.4 shows the percentage of learners attaining at each PISA science proficiency level in each nation of the UK. Around one quarter of learners in Wales (27%) were low performing, attaining below Level 2. The percentage of learners who attained below Level 2 in Wales was significantly higher than in England (19%) and Northern Ireland (23%) and not significantly different to Scotland (24%). In Wales, 6% of learners were top performing, attaining at Level 5 or at Level 6, which was not significantly different to the proportion in Northern Ireland (7%) or Scotland (7%). The percentage of learners in England (11%) attaining at Level 5 or at Level 6 was significantly higher than in Wales.

Figure 9.4: Percentage of learners achieving each science proficiency level by UK nation

Nation	Below L2	L2	L3	L4	L5 or L6
Wales	27%	28%	25%	14%	6%
England	*19%	*24%	27%	*20%	*11%
Northern Ireland	*23%	25%	27%	*18%	7%
Scotland	24%	26%	26%	*17%	7%

Base: All participating learners.
An asterisk (*) indicates where a percentage was significantly different to the equivalent percentage for Wales. Percentages may appear inconsistent due to rounding.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

9.6 Performance over time

Figure 9.5 shows how mathematics scores for each nation have changed over the ten-year period of 2012 to 2022. As shown in previous chapters, the differences between the 2018 and 2022 scores were statistically significant in all cases.

In Wales, the average score for mathematics had decreased by 21 points from 487 in 2018 to 466 in 2022 (similar to the score of 468 in 2012). Statistically significant decreases between 2018 and 2022 were also found for England (12 points), Northern Ireland (17 points) and Scotland (18 points).

Figure 9.5: PISA average mathematics score by UK nation over time

Overall average mathematics score
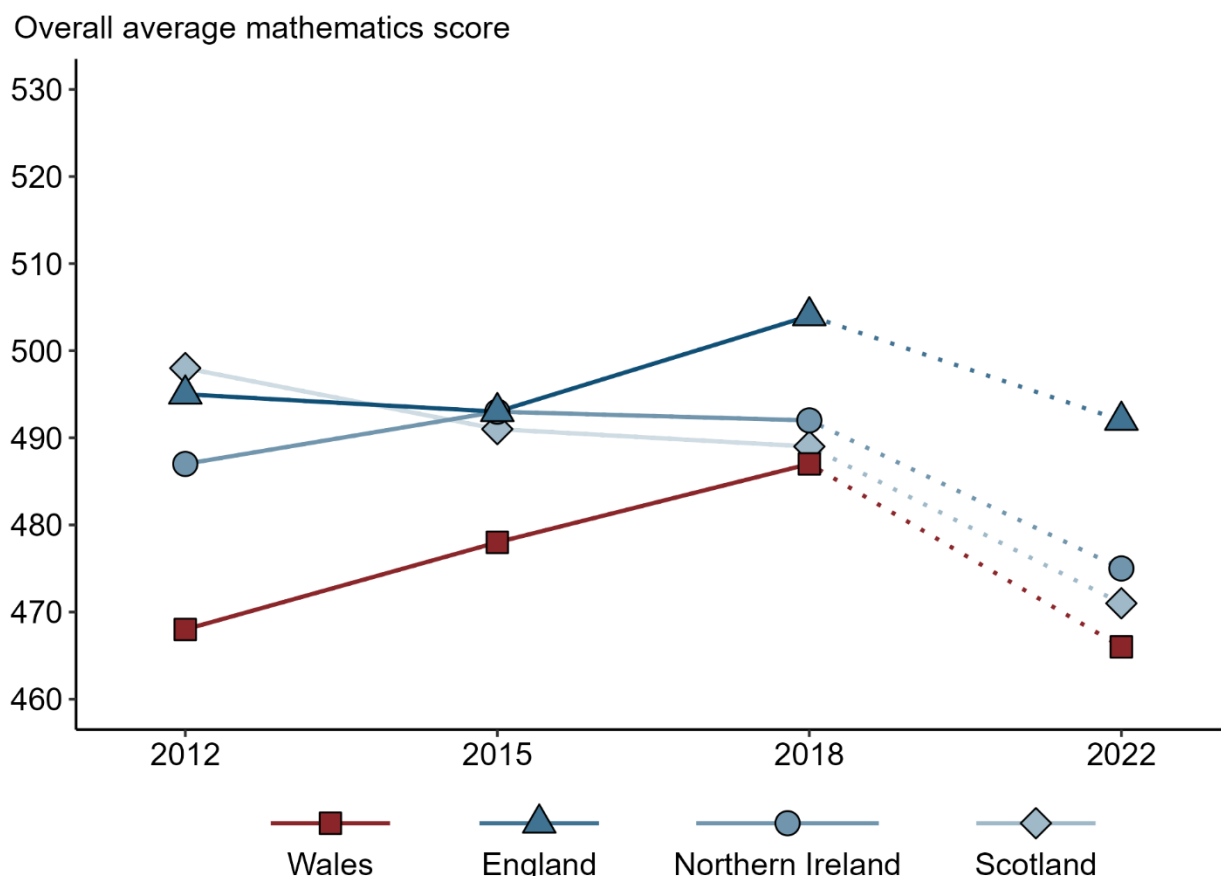
Nation	2012	2015	2018	2022
Wales	468	*478	*487	466
England	495	493	*504	492
Northern Ireland	*487	*493	*492	475
Scotland	*498	*491	*489	471

Base: All participating learners.
An asterisk (*) indicates where a UK nation's score was significantly different to their score in 2022.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Over the longer term, the average mathematics score for Wales in 2022 (466) was not significantly below the score in 2012 (468). The difference between the average scores in 2012 and 2022 were statistically significant for Scotland (a decline of 28 points) and Northern Ireland (a decline of 12 points) but not for England.

Figure 9.6 shows how the average reading scores for each UK nation have changed over the ten year period of 2012 to 2022. A similar, if less pronounced, pattern is apparent for reading. The average score for reading had decreased by 18 points in Wales, falling from 483 in 2018 to 466 in 2022. Significant decreases were also found for Scotland (11 points), Northern Ireland (16 points) and England (9 points).

Figure 9.6: PISA average reading score by UK nation over time

Overall average reading score
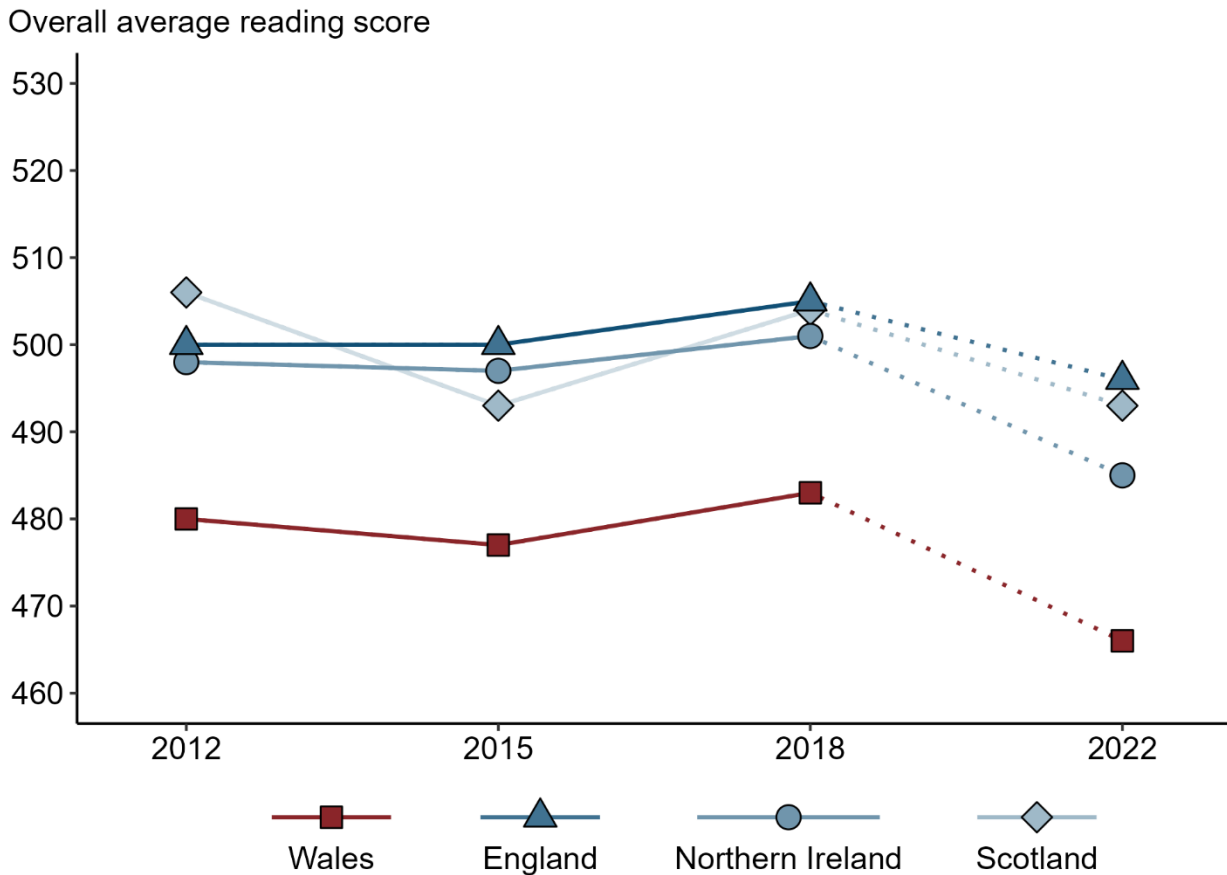
Nation	2012	2015	2018	2022
Wales	480	477	*483	466
England	500	500	*505	496
Northern Ireland	498	497	*501	485
Scotland	506	493	*504	493

Base: All participating learners.
An asterisk (*) indicates where a UK nation's score was significantly different to their score in 2022.
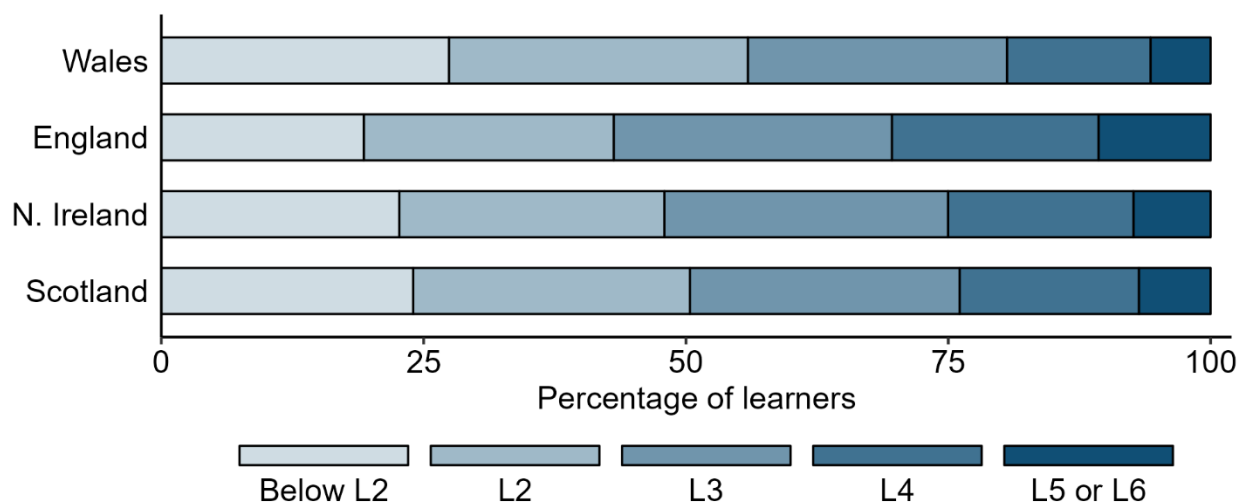*Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.*

Source: OECD, PISA 2022

When considering the longer term comparison between the average scores in 2012 and those in 2022, it is important to note that none of the differences in any nation reached the threshold for statistical significance.

Figure 9.7 shows how science scores have changed over time for each UK nation. The average score for science in Wales (473) was significantly less than the score from 2018 (488), a 15 point decline. The differences between the 2022 and 2018 average scores are not statistically significant for England, Northern Ireland or Scotland.

Figure 9.7: PISA average science score by UK nation over time

Overall average science score

Nation	2012	2015	2018	2022
Wales	*491	*485	*488	473
England	516	*512	507	503
Northern Ireland	*507	*500	491	488
Scotland	*513	*497	490	483

Base: All participating learners.
An asterisk (*) indicates where a UK nation's score was significantly different to their score in 2022.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Over the longer term, the average science score for Wales in 2022 (473) was significantly below the score in 2012 (491), a difference of 18 points. The difference between the average scores in 2012 and 2022 was also statistically significant for Scotland (a decline of 30 points) and Northern Ireland (a decline of 19 points) but not for England.

9.7 Scores of higher- and lower-performing learners

This section compares the performance of the highest and lowest achieving groups in each UK nation. To undertake this analysis, learner scores for each nation are arranged

in rank order and the proportion of learners achieving specific scores are calculated. Two scores can then be compared – the 10th percentile, which represents lowest achieving learners, and the 90th percentile, which represents higher achieving learners. The 90th percentile is the score above which the highest-performing 10% of learners obtain, while the 10th percentile is the score below which the lowest-performing 10% of learners obtain. Figure 9.8 shows the 10th and 90th percentile scores for mathematics, reading and science for each UK nation and provides the difference (the gap) between these two scores.

Figure 9.8: Range between 10th and 90th percentile scores by domain and nation

Mathematics
- Wales: 351 — Range = 233 — 584
- England: 366 — Range = 252 — 617
- N. Ireland: 354 — Range = 242 — 597
- Scotland: 352 — Range = 243 — 595

Reading
- Wales: 334 — Range = 263 — 597
- England: 359 — Range = 269 — 628
- N. Ireland: 353 — Range = 259 — 612
- Scotland: 361 — Range = 263 — 623

Science
- Wales: 348 — Range = 255 — 603
- England: 365 — Range = 272 — 637
- N. Ireland: 356 — Range = 262 — 618
- Scotland: 353 — Range = 261 — 614

Distribution of subject scores

| Nation	Mathematics 90th– 10th percentile	Reading 90th– 10th percentile	Science 90th– 10th percentile
Wales	233	263	255
England	252	269	272
Northern Ireland	242	259	262
Scotland	243	263	261

Base: All participating learners.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

When comparing the size of the gaps between the 90th and 10th percentile for each UK nation and each subject domain it is important to note that the differences between them are not statistically significant. The difference between the scores of the highest and lowest achieving learners was therefore similar in each of the UK nations, with each nation exhibiting a similar range of scores across their learners (the differences between

the average scores of the UK nations therefore represent differences across the full attainment range).

9.8 Gender differences

This section provides the average PISA scores for boys and girls in each subject domain in each UK nation. In the following tables, the difference between these scores was determined by subtracting the boys' average score from the girls' average score. A positive difference represents a gender difference favouring girls and a negative difference represents a gender difference favouring boys.

Table 9.2 displays the average scores for mathematics, showing that, for all four UK nations, boys had a significantly higher average score than girls. The difference in Wales was 9 points, compared to 12 points in Northern Ireland, 15 points in England and 16 points in Scotland.

Table 9.2: PISA average mathematics score gender difference by nation

Nation	Girls average score	Boys average score	Difference
Wales	461	470	−9
England	485	499	−15
Northern Ireland	469	481	−12
Scotland	463	478	−16

Difference calculated as girls' score – boys' score
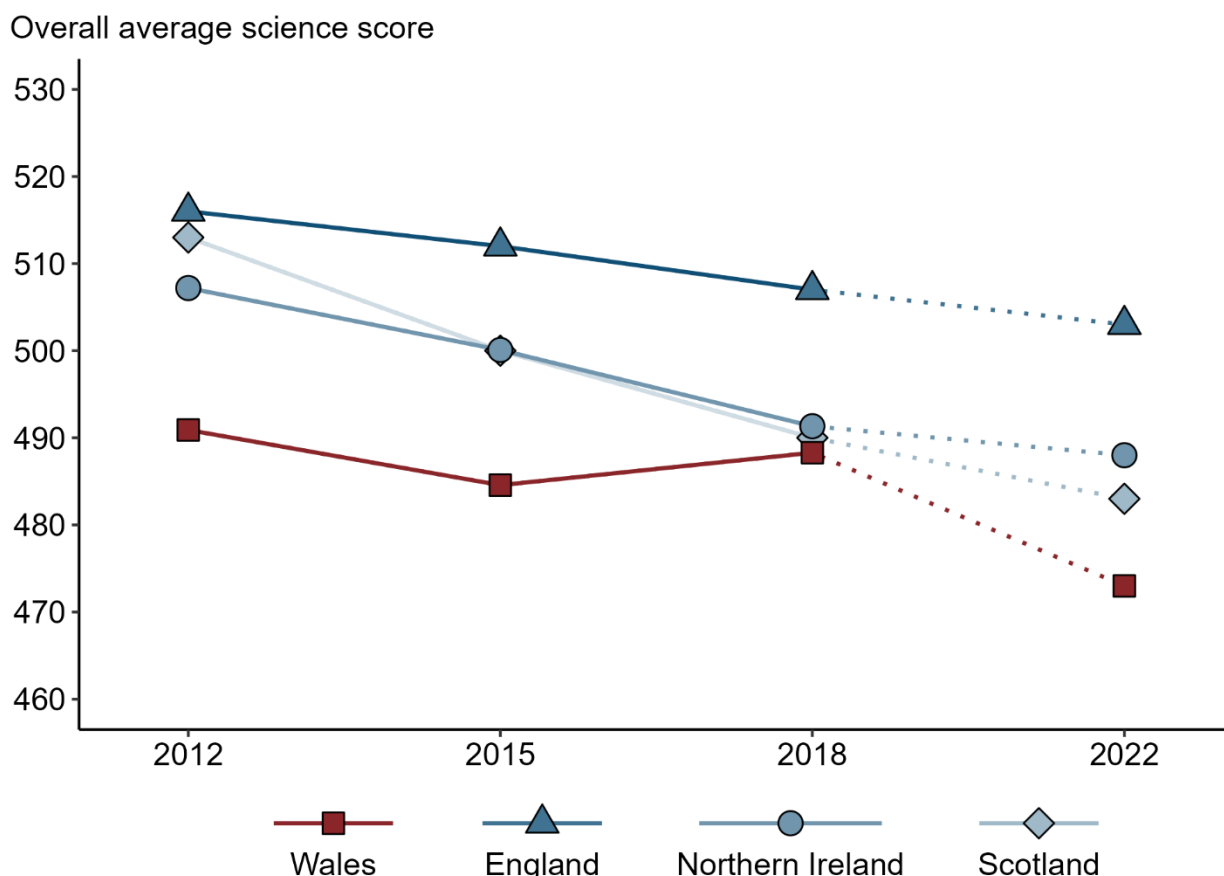*Base: All participating learners.*
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Table 9.3 shows the average PISA reading scores by gender for each nation. For reading, girls had a significantly higher average score than boys in all four UK nations with the difference between the two being 19 points for Wales. The difference between the average scores for boys and girls was similar for Northern Ireland (18 points), Scotland (18 points) and England (16 points).

Table 9.3: PISA reading score gender difference by nation

Nation	Girls average score	Boys average score	Difference
Wales	475	456	19
England	505	488	16
Northern Ireland	494	476	18
Scotland	502	484	18

Difference calculated as girls' score – boys' score
Base: All participating learners in Wales.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

Table 9.4 shows the average PISA science scores by gender. It is important to note that the gender differences for science were not statistically significant for any of the UK nations.

Table 9.4: PISA average science score gender difference by nation

Nation	Girls average score	Boys average score	Difference
Wales	469	477	−7
England	499	507	−8
Northern Ireland	485	492	−6
Scotland	481	485	−4

Difference calculated as girls' score – boys' score
Base: All participating learners.
Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings. Ranges may appear inconsistent with scores due to rounding.

Source: OECD, PISA 2022

9.9 The relationship between socioeconomic status and performance

This section will explore how different socioeconomic groups perform relative to each other across the UK nations. As in previous chapters, learners are divided into quartiles on the basis of their score on the PISA index of economic, social and cultural status (ESCS). The first quartile represents the most disadvantaged learners and the fourth quartile the least disadvantaged learners. The ESCS is derived from their responses in relation to questions about their family background. Findings in this section should be considered particularly cautiously because, along with the persistent caveat about some

of PISA's sampling standards not being met by the UK nations, it was also true that some participating learners did not provide sufficient information for their ESCS quartile to be determined (the percentage of learners in each nation for which ESCS data was missing is presented under the following tables).

Figure 9.9 shows the average mathematics scores for learners in the first and last ESCS quartiles for each of the UK nations (in 2022). Across all nations, there was a significant difference in the average performance of learners from the highest and lowest ESCS groups such that learners from relatively less disadvantaged backgrounds obtained higher scores than those from relatively more disadvantaged backgrounds. When comparing the first quartile to the fourth, the performance gap for Wales was 76 points. This gap was significantly smaller than the one for Scotland (98), but not significantly different to the gaps for either England or Northern Ireland.

Figure 9.9: Average PISA mathematics score for first and fourth ESCS quartiles

Difference in mathematics scores by ESCS quartile
(average score of ESCS quartile 4 - ESCS quartile 1)
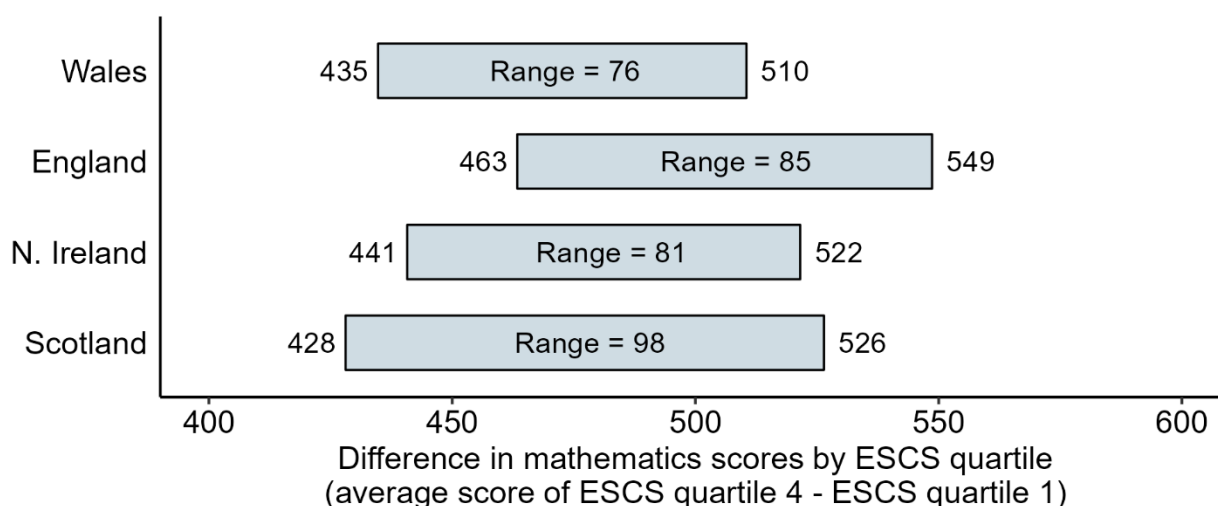
Nation	First ESCS quartile average mathematics score	Fourth ESCS quartile average mathematics score	Difference (fourth quartile score minus first quartile score)
Wales	435	510	76
England	463	549	85
Northern Ireland	441	522	81
Scotland	428	526	*98

ESCS data is missing or unavailable for around 23% of learners in England, 9% of learners in Northern Ireland, 7% of learners in Scotland and 16% of learners in Wales. An asterisk (*) indicates where the range (gap) between a UK nation's fourth and first quartile score was significantly different to the range between the fourth and first quartile score for Wales.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Table 9.5 shows the average reading scores for learners in the first and last ESCS quartiles for each of the UK nations. All within nation differences between the first and fourth ESCS quartiles were statistically significant. Learners from less disadvantaged socioeconomic backgrounds generally achieve higher scores than those from more disadvantaged backgrounds. When comparing the first quartile to the fourth quartile, the gap between average reading scores in Wales was 65 points. As was the case for mathematics, the performance gap between the highest and lowest ESCS groups is significantly smaller than the gap for Scotland (89) but not significantly different to the gaps for England or Northern Ireland.

Table 9.5: Average PISA reading score for first and fourth ESCS quartiles

Nation	First ESCS quartile average reading score	Fourth ESCS quartile average reading score	Difference (fourth quartile score minus first quartile score)
Wales	441	506	65
England	471	553	82
Northern Ireland	452	530	78
Scotland	457	545	*89

ESCS data is missing or unavailable for around 23% of learners in England, 9% of learners in Northern Ireland, 7% of learners in Scotland and 16% of learners in Wales. An asterisk (*) indicates where the range (gap) between a UK nation's fourth and first quartile score was significantly different to the range between the fourth and first quartile score for Wales.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

A similar pattern can be observed for PISA science scores (Table 9.6). The difference between average science scores obtained by the lowest and highest ESCS quartiles for Wales was 81 points. As with mathematics and reading, the differences in average score between the first and fourth ESCS quartiles were statistically significant within all UK nations. For science, the performance gaps for England, Northern Ireland and Scotland were not significantly different to the gap for Wales.

Table 9.6: Average PISA science score for first and fourth ESCS quartiles

Nation	First ESCS quartile average science score	Fourth ESCS quartile average science score	Difference (fourth quartile score minus first quartile score)
Wales	441	522	81
England	471	563	92
Northern Ireland	452	538	86
Scotland	444	536	92

ESCS data is missing or unavailable for around 23% of learners in England, 9% of learners in Northern Ireland, 7% of learners in Scotland and 16% of learners in Wales.

Caution is required when interpreting estimates because one or more PISA sampling standards were not met. For Wales, potential bias in the findings may be somewhat mitigated statistically as part of the analysis process, through the use of weightings.

Source: OECD, PISA 2022

10 References

Dweck, C. S. (2006). *Mindset: The new psychology of success.* Random House.

Dweck, C. S. (2016). What having a "growth mindset" actually means. *Harvard business review*, *13*(2), 2-5.

Kreiner, S. & Christensen, K.B. (2014) Analyses of model fit and robustness. A new look at the PISA scaling model underlying ranking of countries according to reading literacy. *Psychometrika*, 79 (2), 210-231.

OECD (2023a). *PISA 2022 participants*. OECD.
https://www.oecd.org/pisa/aboutpisa/pisa-participants.htm

OECD (2023b). *PISA 2022 Assessment and Analytical Framework.* OECD.
https://www.oecd-ilibrary.org/education/pisa-2022-assessment-and-analytical-framework_dfe0bf9c-en

OECD (2023c). *PISA 2022 Mathematics Framework*. OECD. https://pisa2022-maths.oecd.org/ca/index.html

OECD (2023d). *PISA 2022 Technical Standards*. OECD.
https://www.oecd.org/pisa/pisaproducts/PISA-2022-Technical-Standards.pdf

OECD (2023e). *PISA 2022 Results.* OECD. https://www.oecd.org/pisa/publications/

OECD (Forthcoming). *PISA 2022 Technical Report*. OECD.
https://www.oecd.org/pisa/publications/

Rutkowski, L., Rutkowski, D. & Zhou, Y. (2016) Parameter estimation methods and the stability of achievement estimates and system rankings: Another look at the PISA model. *International Journal of Testing*, *16*(1), 1-2

Sizmur, J., Ager, R., Bradshaw, J., Classick, R., Galvis, M., Packer, J., Thomas, D. & Wheater, R. (2019). *Achievement of 15-Year Olds in Wales: PISA 2018 National Report*. Welsh Government. https://www.gov.wales/sites/default/files/statistics-and-research/2019-12/achievement-15-year-olds-program-international-student-assessment-pisa-national-report-2018_0.pdf

Appendix A
PISA 2022 Wales non-response bias analysis

PISA 2022 Wales non-response bias analysis summary

The Programme for International Student Assessment (PISA) is an international study that assesses the knowledge, skills and competencies of 15-year-old learners more generally. It is impractical for the PISA assessment to be administered to every single learner in each participating country. Participating countries therefore assess a sample of their eligible learners.

How are learners and schools selected?

Schools and learners are randomly selected to participate in PISA through a two-stage stratified sampling design. For PISA 2022, a representative sample of 125 eligible schools in Wales was selected by the international PISA Sampling organisation Westat. The sampling design used considers both the type of school and the region of Wales that the school is in to ensure that the sample is representative of the different schools across Wales. Larger schools also had a greater chance of being included in the sample because they had more 15-year-old learners. Once schools agreed to participate, 40 eligible learners were then randomly selected from each school.

Data was collected from schools during November and December 2022. This was a difficult time for some schools and not all were able to take part. As a result, the final participating sample of schools and learners in Wales was smaller than the targets of 85% of schools and 80% of learners taking part set by the OECD, with 58% of the original sample of schools participating and 77% of all sampled learners across responding schools.

What is a non-response bias analysis?

To determine how well the achieved sample in Wales in PISA 2022 reflects the population of 15-year-old learners and to assess the quality of the achieved sample we compared the background characteristics of the schools and learners taking part with the known characteristics of eligible schools and learners in Wales.

This analysis can tell us if particular groups of schools or learners were more or less likely to participate in PISA 2022 than other groups. For example, whether more boys chose to participate than girls or whether more schools in the north of Wales chose to participate than schools in the south. If some groups were less likely to participate than others we would say that our data are biased and the analysis may not accurately represent all 15-year-old learners in Wales.

What did we find out?

The school sample of 89 schools was largely representative of all schools in Wales with regard to many characteristics: school region, the percentage of learners with additional learning needs, the percentage of learners with English as an additional language, and the average percentage of learners eligible for free school meals over the last 3 years.

There was initial evidence of potential bias in relation to the average GCSE performance of learners in schools, with schools including lower-attaining learners on average underrepresented in the final sample and schools including higher-attaining learners on average were overrepresented. This bias was effectively reduced through adjustments to the weights used in the analysis.

The learner sample of 2,568 learners was also found to be largely representative of learners more generally in Wales.

The bias identified in the school sample by this analysis may also affect previous cycles of PISA and other education systems where a non-response bias analysis has not been required or has not been possible because the necessary data are not available. Caution is required when considering trend or country comparisons which may have been affected by this bias.

Interpreting the PISA 2022 results

There is always some uncertainty in the precision of what is being measured in survey research such as PISA. This uncertainty is taken into account in the analysis, for example when considering differences in performance between countries.

Although the non-response analysis has identified some potential issues with regard to how much the learners who were sampled can be said to represent all 15-year-old learners in Wales, the PISA 2022 results for Wales can still provide a broad picture of their performance. Where the analysis shows stronger performance than in previous years or in comparison with other education systems, we cannot be certain of the extent to which this performance was due to general changes in the population of 15-year-olds in Wales or due to higher attaining learners being overrepresented in the data. This is also the case for the previous PISA cycles or the other education systems that we are making comparisons with.

A.1 Introduction

The Programme for International Student Assessment (PISA) is a large international comparative study of the knowledge, skills, and competencies of 15-year-old learners in the domains of mathematics literacy, reading literacy, and science literacy. To provide valid estimates of learners' achievement in these domains in each of the participating education systems, national samples of learners were selected to participate in the study and represent their education system's full population of 15-year-old learners.

PISA uses a two-stage stratified sampling design. The first stage selects schools using a systematic probability-proportionate-to-size technique. School size is the estimated age-eligible enrolment of the school. In Wales, schools were also grouped into two explicit strata, school type and region, before being systematically sampled using probabilities proportional to the school size. For most education systems each school that is chosen in the initial sample, two replacement schools were also identified with similar characteristics to the originally sampled school. In Wales this was not possible as there were not enough schools within each of the explicit strata.

The second stage randomly selects up to 40 eligible learners within each sampled school. The OECD requires that participating learners were aged between 15 years and 3 months and 16 years and 2 months at the beginning of the testing period. Learners may be excluded from participating in PISA 2022 if they have Additional Learning Needs (ALN) that result in them being unable to take the test, or they have insufficient English or Welsh language experience that results in them being unable to take the test. The Wales PISA sample consisted of 127 eligible schools having at least one learner in this age range.

Data collection in Wales took place in November and December 2022. Of the 127 schools in the original sample, 83 agreed to participate, along with a further 15 replacement schools, but 8 schools withdrew before data collection. Data was therefore collected from 75 schools in the original sample and 15 replacement schools. Of this total, one replacement school was omitted from the response rate adjudication process, leaving a total of 75 schools from the original sample and 14 replacement schools. Two original sample schools who did not participate were also excluded during the response rate adjudication process, leaving 125 schools in the original sample. In Wales, 2,183 learners from original sample schools and 385 learners from replacement schools participated. Learners in participating schools who did not participate were not replaced.

The final weighted school response rates for Wales were 60.3% before replacement, and 71.3% after replacement. These rates for Wales were lower than the response-rate targets set by the OECD (either 85% of original sample schools, or 94.3% after replacement given the achieved original response-rate across Wales). The final weighted learner response rate for Wales was 74.6% including learners in replacement schools. This rate was lower than the automatically acceptable response-rate target set by the OECD of at least 80% of all sampled learners across responding schools.

This non-response bias analysis report explores potential sources of bias due to non-response and determines the extent to which the weight adjustments alleviate any bias that was found. This report uses the full achieved sample of 89 schools (75 from the original sample) from which some learner data was collected as the basis for the school-level analysis, and the full achieved sample of 2,568 learners (2,183 from the original sample) as the basis for the learner-level analysis.

A.2 Methodology

A.2.1. School-level analysis

The non-response bias analysis at the school level compared the characteristics of the original sample of schools to those of the participating schools. This analysis was conducted in two parts:

1. Analysis of the original sample of schools (before replacement). The characteristics of the participating schools from the original sample (N=75) was compared with those of the original school sample (N=125). In each group, schools were weighted by their school base weights, excluding any non-response adjustment factor.

2. Analysis of the participating final sample (with replacements). The characteristics of all the participating schools (N=89), which includes 14 schools that were used as replacements for non-responding schools from the original sample, was compared to the original school sample (N=125). The participating schools were weighted by their non-response adjusted weights.

The first part of the analysis indicates the potential for non-response bias that was introduced through school non-response. The second indicates the potential for bias after accounting for the mitigating effects of both replacement and non-response weight adjustments.

In addition to weighting the schools by their school base weights or non-response adjusted final weights, the analysis also includes these weights multiplied by the school enrolment of 15-year-olds. This gives an estimate in terms of the survey population of 15-year-olds for each characteristic.

Participating schools and the total original school sample were compared using matched achievement data and school characteristic data from the Welsh Government.

For the school-level non-response bias analysis the matched variables used include:

- Percentage of learners who have additional learning needs (ALN)

- Percentage of learners with English as an additional language (EAL)

- Percentage of learners who have been eligible for free school meals (FSM) on average across the last 3 years.

In addition, the analysis included the stratification variable (school attainment band[16]) and the estimated number of 15-year-old eligible learners enrolled from the school sampling frame.

A.2.2. Learner-level analysis

The non-response bias analysis at the learner level compared the characteristics of the original sample of learners to those of the participating learners. This analysis was conducted in two parts:

1. Analysis of the participating learners: The distribution of the participating learners (N = 2,568) was compared to the distribution of the sampled learners that did not participate in PISA. Note that these analyses only focus on learners within the participating schools, and not learners from sampled schools that did not participate in the study. Learners were weighted by their learner base weights, excluding any non-response adjustment factor. In addition, the distribution of the participating learners was compared to the original sample schools weighted by the school base weights multiplied by the school enrolment of 15-year-olds. This gives an estimate in terms of the survey population of 15-year-olds for each characteristic.

2. Analysis of the participating final sample with non-response weight adjustments: The distribution of the participating learners (N = 2,568) was compared to the same estimate of the survey population of 15-year-olds for each characteristic used in the previous part. The participating learners were weighted by their non-response adjusted weights.

The first part of the analysis indicates the potential for non-response bias that was introduced through learner non-response. The second indicates the potential for bias after accounting for the mitigating effects of both replacement and non-response weight adjustments at the school and learner levels.

Learners in participating schools were compared using matched learner characteristic data from the Pupil Level Annual School Census (PLASC).

For the learner-level non-response bias analysis, the matched variables used include:

- Whether the learner was eligible for free school meals (FSM).
- Whether the learner has English as an Additional Language (EAL)
- Whether the learner has additional learning needs (ALN)

---

[16] The original categories correspond to the quartiles of the proportion of learners achieving 5 or more GCSEs at or above Grade C of the schools in school year 2018/19 and one category for schools where these data were missing

In addition, the analysis included the school-level stratification variables (school type, region, school gender and school attainment band), learner gender taken from the datasets provided by Westat, and the estimated number of 15-year-old eligible learners enrolled from the school sampling frame.

For each of the matched variables an additional category of unknown was added to account for the number of learners with these data missing.

A.2.3. Statistical analysis

For categorical variables, the distribution of frame characteristics for participants was compared with the distribution for non-participants. The hypothesis of independence between the characteristic and participation status was tested using a Rao-Scott modified Chi-square statistic at the 95% confidence level. For continuous variables, summary means were calculated and the difference between means was tested using a t-test. The p-values for the tests are presented in the tables. The statistical significance of differences between participants and non-participants is identical to that which would result from comparing participants and the total sample of which they are a subset. The bias and relative bias are also shown in tables where appropriate. The bias is the difference between the respective estimates for the participants and the total sample. The relative bias is calculated as the bias divided by the estimate from the total sample. The relative bias is a measure of the size of the bias compared to the total sample estimate.

In addition, logistic regression models were used to provide a multivariate analysis that examined the relationship of participation status to learner and school characteristics.

All statistical analyses were performed in R version 4.2.2 using the survey package[17] to account for the complex sample design. The analysis used the base weights, replicate weights and non-response adjusted weights provided by Westat. The international weighting procedures form non-response adjustment classes by cross-classifying the explicit and implicit stratification variables.

A.3 Original school sample (before replacement)

This section presents the non-response bias analysis based on the original sample of 125 schools. The distribution of the participating schools from the original sample was compared to the total original sample. School base weights were used for both the total original sample and the participating schools.

The distribution of schools from the original sample by the implicit stratification variable (school attainment band) is shown in Table A.1. There were no statistically significant relationships between participation status and school attainment band. However, a

---

[17] Lumley T (2020). "survey: analysis of complex survey samples." R package version 4.0.

relative bias greater than an absolute value of 10% was observed for schools in the highest and the second attainment bands. This suggests a potential source of bias in relation to school attainment with a larger proportion of schools in the highest attainment band participating in PISA 2022 than schools in the lowest two attainment bands.

Table A.1: Percentage distribution of schools in Wales' original sample for PISA 2022 by the implicit stratification variable

School characteristic	Original sample %	Participating schools %	Bias	Relative bias	Non-participating schools %
Attainment band: Low 1	23.8	21.4	2.4	0.10	28.0
Attainment band: 2	21.9	18.8	3.1	0.14	27.1
Attainment band: 4	22.7	21.8	0.9	0.04	24.3
Attainment band: High 5	22.7	29.3	−6.6	−0.29	11.4
Attainment band: Missing	8.9	8.7	0.2	0.02	9.3

Base: Original sample: n = 125; Participating schools: n = 75; Non-participating schools: n = 50
School attainment band: $\chi2(ndf = 3.7, ddf = 214) = 1.16, p = .33$
Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools –original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. The p-value for the chi-square test was calculated by testing the difference in distributions between the participating and non-participating schools. Schools were weighted by their school base weights.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

When the schools were weighted by their enrolled eligible 15-year-old learners, there was also no statistically significant relationship between participation status and school attainment band. However, the relative biases in the higher attainment bands were greater than an absolute value of 10% suggesting that learners in schools in the highest attainment bands may be overrepresented in the final sample as shown in Table A.2.

Table A.2: Percentage distribution of schools weighted by enrolled eligible 15-year-old learners in Wales' original sample for PISA 2022 by the implicit stratification variable

School characteristic	Original sample %	Participating schools %	Bias	Relative bias	Non-participating schools %
Attainment band: Low 1	24.0	23.7	0.3	0.01	24.5
Attainment band: 2	23.4	21.4	2.0	0.09	26.4
Attainment band: 4	24.9	22.0	2.9	0.12	29.5
Attainment band: High 5	24.2	29.3	−5.1	−0.21	16.4
Attainment band: Missing	3.5	3.7	−0.2	−0.06	3.2

Base: Original sample: sum of weights = 34,052; Participating schools: sum of weights = 20,545; Non-participating schools: sum of weights = 13,507

School attainment band: χ^2(ndf = 3.26, ddf = 189)= 0.86, p = .47

Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools – original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. The p-value for the chi-square test was calculated by testing the difference in distributions between the participating and non-participating schools. Schools were weighted by their school base weights multiplied by the school enrolment of 15-year-old eligible learners.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

A.3.1. School-level continuous variables

The mean values of the variables related to the percentage of learners who have ALN, the percentage of learners with EAL, and the average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years are given in Table A.3 and Table A.4. The differences in the mean percentage of learners who have ALN, learners with EAL and the average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years were not significantly different between participating and non-participating schools. However, the relative bias in both tables in relation to the proportion of learners with EAL suggests that these learners may be overrepresented in the participating sample.

Table A.3: School average learner characteristics of schools in Wales' original sample for PISA 2022

School-level learner characteristics	Original sample %	Participating schools %	Bias	Relative bias	Non-participating schools %	*t*-test *p*-value
Average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years	21.0	20.6	0.4	0.02	21.7	0.81
Percentage of learners with additional learning needs (ALN)	15.8	14.7	1.2	0.07	17.5	0.60
Learners who have English as an additional language (EAL)	4.1	4.6	−0.5	−0.11	3.5	0.61

Base: Original sample: n = 108, missing = 17 (n = 96, missing = 29 for EAL measure);
Participating schools: n = 64, missing = 11 (n = 54, missing = 21 for EAL measure);
Non-participating schools: n = 44, missing = 6 (n = 42, missing = 8 for EAL measure);
Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools – original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. The p-value for the t-test was calculated by testing the difference in means between the participating and non-participating schools. Schools were weighted by their school base weights.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

Table A.4: Learner characteristics of schools weighted by enrolled eligible 15-year-old learners in Wales' original sample for PISA 2022

School-level learner characteristics	Original sample %	Participating schools %	Bias	Relative bias	Non-participating schools %	*t*-test *p*-value
Average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years	20.8	20.6	0.2	0.01	21.0	0.98
Percentage of learners with additional learning needs (ALN)	15.3	14.1	1.2	0.08	16.8	0.48
Percentage of learners with English as an additional language (EAL)	4.4	5.0	−0.6	−0.14	3.6	0.34

Base: Original sample: sum of weights = 29,867, missing proportion = 0.1% (sum of weights = 26,514, missing proportion = 0.3% for EAL measure);
Participating schools: sum of weights = 17,604, missing proportion = 0.2% (sum of weights = 14,810, missing proportion = 0.4% for EAL measure);
Non-participating schools: sum of weights = 12,263, missing proportion = 0.1% (sum of weights = 11,703, missing proportion = 0.2% for EAL measure);
Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools – original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. The p-value for the t-test was calculated by testing the difference in means between the participating and non-participating schools. Schools were weighted by their school base weights multiplied by the learner enrolment of 15-year-old eligible learners.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

A.3.2. Regression models

The logistic regression models the probability of participation in PISA in relation to the implicit stratification variable and the percentage of learners who have ALN, the percentage of learners with EAL and the average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years as the independent variables. Table A.5 and Table A.6 show that no significant relationship between response status and each of these characteristics.

Table A.5: Logistic regression modelling relationship of response status to school characteristics in Wales' original sample for PISA 2022

Variable	Estimate	Standard Error	*t*-value	*p*-value
Intercept	0.21	1.32	0.16	0.87
Attainment band: Low 1	−0.24	0.73	−0.34	0.74
Attainment band: 2	0	0	-	-
Attainment band: 4	−0.34	0.79	−0.43	0.67
Attainment band: High 5	0.80	1.10	0.72	0.47
Average percentage of learners who have not been eligible for free school meals (FSM) over the last 3 years	0	0	-	-
Average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years	0.02	0.05	0.38	0.70
Percentage of learners without additional learning needs (ALN)	0	0	-	-
Percentage of learners with additional learning needs (ALN)	0.00	0.03	−0.02	0.98
Percentage of learners without English as an additional language	0	0	-	-
Percentage of learners with English as an additional language (EAL)	0.02	0.05	0.41	0.69

*p<0.05, **p<0.01, ***p<0.001*
Note: Schools were weighted by their school base weights

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

Table A.6: Logistic regression modelling relationship of response status to school characteristics in Wales' original sample for PISA 2022, weighted by school enrolment of 15-year-old eligible learners

Variable	Estimate	Standard Error	*t*-value	*p*-value
Intercept	0.05	1.35	0.04	0.97
Attainment band: Low 1	0.21	0.73	0.29	0.77
Attainment band: 2	0	0	-	-
Attainment band: 4	−0.25	0.76	−0.32	0.75
Attainment band: High 5	0.84	1.06	0.79	0.43
Average percentage of learners who have not been eligible for free school meals (FSM) over the last 3 years	0	0	-	-
Average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years	0.01	0.04	0.28	0.78
Percentage of learners without additional learning needs (ALN)	0	0	-	-
Percentage of learners with additional learning needs (ALN)	−0.01	0.03	−0.40	0.69
Percentage of learners without English as an additional language	0	0	-	-
Percentage of learners with English as an additional language (EAL)	0.04	0.04	0.89	0.38

*p<0.05, **p<0.01, ***p<0.001*
Note: Schools were weighted by their school base weights multiplied by the school enrolment of 15-year-old eligible learners.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

A.4 Non-response adjusted participating final sample (with replacements)

This section presents the non-response bias analysis based on the original sample of 125 schools. The distribution of the final participating sample (89), including participating replacement schools, was compared to the schools in the original sample. School base weights were used for the original sample of schools, whereas non-response adjusted weights were used for the participating schools.

A.4.1. Categorical variables

The distribution of schools from the original sample by the implicit stratification variable is shown in comparison with the participating final sample in Table A.7 and Table A.8. The absolute value of the relative bias for schools in all the attainment bands was greater than 10% indicating potential bias in the schools that participated related to school attainment remains after adjustments for non-response. However when the schools were weighted by the school enrolment of 15-year-old eligible learners the relative bias was reduced with only the highest attainment band continuing to have an absolute relative bias greater than 10%.

Table A.7: Percentage distribution of schools in Wales' final participating sample for PISA 2022 compared with the original sample by the implicit stratification variable.

School characteristic	Original sample %	Participating schools %	Bias	Relative bias
Attainment band: Low 1	23.8	19.6	4	0.18
Attainment band: 2	21.9	18.9	3	0.14
Attainment band: 4	22.7	25.0	−2	−0.10
Attainment band: High 5	22.7	28.7	−6	−0.26
Attainment band: Missing	8.9	7.8	1	0.12

Base: Original sample: n = 125; Participating Schools: n = 89
Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools – original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. Schools were weighted by their school base weights (original sample) and non-response adjusted school weights (final participating sample).

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

Table A.8: Percentage distribution of schools in Wales' final participating sample for PISA 2022 compared with the original sample by the implicit stratification variable, weighted by school enrolment of 15-year-old eligible learners.

School characteristic	Original sample %	Participating schools %	Bias	Relative bias
Attainment band: Low 1	24.0	21.9	2	0.09
Attainment band: 2	23.4	21.2	2	0.09
Attainment band: 4	24.9	25.0	0	0.00
Attainment band: High 5	24.2	28.6	−4	−0.18
Attainment band: Missing	3.5	3.3	0	0.06

Base: Original sample: sum of weights = 34,052; Participating Schools: n = 28,773
Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools – original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. Schools were weighted by their school base weights (original sample) and non-response adjusted school weights (final participating sample) multiplied by the school enrolment of 15-year-old eligible learners.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

A.4.2. School-level continuous variables

The mean values of the variables related to the characteristics of each school in the final participating sample are shown in comparison with the original sample in Table A.9 and Table A.10 for the percentage of learners with additional learning needs (ALN), percentage of learners with EAL, and the average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years between schools in the final participating sample and the original sample. The absolute values of the relative bias for the percentage of learners with ALN and the percentage of learners eligible for free school meals were less than 10%, which indicates minimal potential bias due to non-response in relation to these learner characteristics. However, the relative bias for the percentage of learners with EAL continues to indicate that these learners may be overrepresented in the final sample.

Table A.9: learner characteristics of schools in Wales' final participating sample for PISA 2022 compared with the original sample

School-level learner characteristics	Original sample %	Participating schools %	Bias	Relative bias
Average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years	21.0	20.5	0.6	0.03
Percentage of learners with additional learning needs (ALN)	15.8	14.8	1.1	0.07
Percentage of learners with English as an additional language (EAL)	4.1	4.8	−0.6	−0.15

Base: Original sample: n = 108, missing = 17 (n = 96, missing = 29 for EAL measure);
Participating schools: n = 64, missing = 11 (n = 54, missing = 21 for EAL measure);
Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools – original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. Schools were weighted by their school base weights.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

Table A.10: learner characteristics of schools in Wales' final participating sample for PISA 2022 compared with the original sample, weighted by enrolled eligible 15-year-old learners

School-level learner characteristics	Original sample %	Participating schools %	Bias	Relative bias
Average percentage of learners who have been eligible for free school meals (FSM) over the last 3 years	20.8	20.6	0.2	0.01
Percentage of learners with additional learning needs (ALN)	15.3	14.2	1.1	0.08
Percentage of learners with English as an additional language (EAL)	4.4	5.2	−0.8	−0.18

Base: Original sample: sum of weights = 29,867, missing proportion = 0.1% (sum of weights = 26,514, missing proportion = 0.3% for EAL measure);
Participating schools: sum of weights = 24,647, missing proportion = 0.1% (sum of weights = 20,998, missing proportion = 0.3% for EAL measure);
Note: Bias was calculated as the difference between the estimates of the participating schools and the original sample (= participating schools – original sample). Relative bias was calculated as the bias divided by the estimate from the original sample. Schools were weighted by their school base weights multiplied by the learner enrolment of 15-year-old eligible learners.

Source: OECD, PISA 2022. Department for Education and Skills (Wales), 2022.

A.5 Comparisons of participating and non-participating learners

This section presents the non-response bias analysis of the participating learners: the distribution of the participating learners (N = 2,568) was compared to the distribution of sampled learners within participating schools that did not participate (N = 958). Learners were weighted by their learner base weights, excluding any non-response adjustment factor. In addition, the distribution of the participating learners was compared to the original sample schools weighted by the school base weights multiplied by the estimated school enrolment of 15-year-olds from the school sampling frame. This gives an estimate in terms of the survey population of 15-year-olds for each characteristic.

A.5.1. School-level categorical variables

Table A.11 shows the proportion of participating learners relative to the proportions of learners in the original sample that attended schools based on the explicit stratification variables used in the school sampling – the type of school they attend, and the region within Wales.

Learners attending independent schools made up 1.9% of the original sample but made up 1.5% of the learners who participated in PISA. This was a significant difference that suggest that learners in independent schools may be underrepresented in the final participating sample. There were no significant differences between the participation rates of learners in schools from different regions of Wales.

Table A.11: Percentage distribution of learners in Wales' final participating sample for PISA 2022 compared with the original sample by explicit stratification variables

School characteristic	Original sample %	Participating learners %	Bias	Relative bias	Non-participating learners %
Independent	1.9	1.5	0.4	0.21	0.4
Maintained	98.1	98.5	−0.4	0.00	99.6
Central South Wales	31.4	31.4	0.0	0.00	30.9
North Wales	21.8	21.2	0.6	0.03	22.6
South East Wales	19.3	19.2	0.1	0.01	19.0
South West and Mid Wales	27.6	28.2	−0.6	−0.02	27.5

Base: Original sample: n = 4976; Participating learners: n = 2,568; Non-participating learners: n = 958.
School type: χ^2(ndf = 1, ddf = 79) = 7.76, p = .01
School region: χ^2(ndf = 2.5, ddf = 197) = 0.11, p = .93
Note: Bias was calculated as the difference between the estimates of the participating learners and the final sample. Relative bias was calculated as the bias divided by the estimate from the final sample. The p-values for chi-square tests were calculated by comparing the participating and non-participating learners. Learners were weighted by their learner base weights. The final sample was weighted by the school base weight multiplied by the number of eligible learners enrolled in the school.

Source: OECD, PISA 2022 and Department for Education and Skills (Wales), PLASC, 2022

Table A.12 shows the proportion of participating learners relative to the proportions of learners in the original sample that attended schools based on the implicit stratification variable used in the school sampling – school-attainment band.

The differences based on school attainment band were statistically significant at the 95% confidence level, suggesting a potential source of bias related to school attainment band. The proportion of participating learners in schools where the school attainment information was not available (4%) may be overrepresented in the final sample. The relative bias for each of the other school attainment bands was small.

Table A.12: Percentage distribution of learners in Wales' final participating sample for PISA 2022 compared with the original sample by the implicit stratification variable

School characteristic	Original sample %	Participating learners %	Bias	Relative bias	Non-participating learners %
Attainment band: Low 1	24.0	24.2	−0.2	−0.01	28.2
Attainment band: 2	23.4	22.0	1.4	0.06	26.7
Attainment band: 4	24.9	25.0	−0.1	0.00	21.7
Attainment band: High 5	24.2	24.9	−0.7	−0.03	21.6
Attainment band: Missing	3.5	3.9	−0.4	−0.11	1.9

Base: Original sample: n = 4976; Participating learners: n = 2,568; non-participating learners: n = 958.
School attainment band: $\chi^2(ndf = 3.37, ddf = 267) = 3.31, p = .02$
Note: Bias was calculated as the difference between the estimates of the participating learners and the final sample. Relative bias was calculated as the bias divided by the estimate from the final sample. The p-values for chi-square tests were calculated by comparing the participating and non-participating learners. Learners were weighted by their learner base weights. The final sample was weighted by the school base weight multiplied by the number of eligible learners enrolled in the school.

A.6 Non-response adjusted participating learner final sample

In this section, the distribution of the participating learners (N = 2,568) before and after non-response weighting adjustments are compared. Where the data were available the distribution is also compared to the estimated study population of 15-year-olds.

A.6.1. School level categorical variables

Table A.13 and Table A.14 show the differences in school-level characteristics between the final sample of learners compared to the group of participating learners after the application of non-response adjusted weights. These tables show that there was no evidence of bias in the participating sample of learners after non-response weighting adjustments by school region (Table A.13) or by school attainment band (Table A.14). However, there remains some evidence of bias in the participating sample of learners after non-response weighting adjustments by school type with learners from independent schools underrepresented.

Table A.13: Percentage distribution of learners in the estimated study population of 15-year-olds compared to Wales' final participating sample for PISA 2022 after adjusting for non-response by explicit stratification variables

School characteristic	Original sample %	Participating sample %	Bias	Relative bias
Independent	1.9	1.2	1	0.37
Maintained	98.1	98.8	−1	−0.01
Central South Wales	31.4	31.4	0	0.00
North Wales	21.8	21.5	0	0.01
South East Wales	19.3	19.3	0	0.00
South West and Mid Wales	27.6	27.8	0	−0.01

Base: Original sample: n = 4976; Participating learners: n = 2,568;
Note: Bias was calculated as the difference between the estimates of the proportion of participating learners and the estimates of the study-population proportion of learners in the original sample. Relative bias was calculated as the bias divided by the estimate from the original sample. Learners were weighted by their learner base weights after adjusting for non-response. The final sample was weighted by the school base weight multiplied by the number of eligible learners enrolled in the school.

Source: OECD, PISA 2022 and Department for Education and Skills (Wales), PLASC, 2022

Table A.14: Percentage distribution of learners in the estimated study population of 15-year-olds compared to Wales' final participating sample for PISA 2022 after adjusting for non-response by the implicit stratification variable.

School characteristics	Original sample %	Participating sample %	Bias	Relative bias
School attainment band: Low 1	24.0	25.0	−1	−0.04
School attainment band: 2	23.4	23.1	0	0.01
School attainment band: 4	24.9	24.7	0	0.01
School attainment band: High 5	24.2	23.9	0	0.01
School attainment band: Missing	3.5	3.4	0	0.03

Base: Original sample: n = 4976; Participating learners: n = 2,568;
Note: Bias was calculated as the difference between the estimates of the proportion of participating learners and the estimates of the study-population proportion of learners in the original sample. Relative bias was calculated as the bias divided by the estimate from the original sample. Learners were weighted by their learner base weights after adjusting for non-response. The final sample was weighted by the school base weight multiplied by the number of eligible learners enrolled in the school.

Source: OECD, PISA 2022 and Department for Education and Skills (Wales), PLASC, 2022

A.7 Summary

Overall, this analysis provides reassurance that the final sample of schools and learners which participated in PISA in 2022 was representative of all schools and learners in Wales.

We first investigated non-response bias at the school level, finding that the final sample does not differ in a statistically meaningful way from the original sample in terms of

school region and in terms of the average percentage of learners eligible for free school meals over the last 3 years, the percentage of learners with additional learning needs (ALN), and the percentage of learners with EAL. However, there was evidence of potential bias in relation to school attainment bands, which was an indicator of learner attainment whereby schools were divided into quartiles (based on the academic performance of the learners at GCSE in 2019). The application of non-response adjusted weights has effectively reduced this potential source of bias.

Similarly, we investigated non-response bias at the learner level, which supported the analysis at the school level, finding that the final sample did not differ in a statistically meaningful way from the original sample in terms of school region or school attainment band with the exception of learners in schools where the attainment band information was not available. The non-response bias adjustments effectively reduced these differences.

This document is available for download at the [Welsh Government's website](.).