Environmental knowledge and attitudes in Ireland's schools:

Findings from TIMSS 2023

Aidan Clerkin, George Piccio, Sylvia Denner, Vasiliki Pitsia and Gráinne McHugh

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Primary

Aedín Ní Thuathail (Irish Primary Principals' Network).

Áine Lynch (National Parents Council – Primary).

Cormac Ó Tuairisg (Gaeloideachas).

Eddie Fox (Educate Together).

Mark Bohan (Department of Education).

Máirín Ní Chéileachair (INTO).

Micheál Killilea (Department of Education, Social Inclusion Unit).

Noreen Fiorentini (Department of Education Inspectorate, Chair).

Patrick Sullivan (National Council for Curriculum and Assessment).

Rory Collins (Oide).

Seán Delaney (Marino Institute of Education).

Post-primary

Anne O'Dwyer (Mary Immaculate College).

Elizabeth Smith (Department of Education).

Mark Bohan (Department of Education).

Gerry Hyde (State Examinations Commission).

Kathy O'Sullivan (University of Galway).

Linda Ramsbottom (Department of Education Inspectorate, Chair).

Liz O'Neill (Department of Education).

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Chapter 1: Introduction

The Trends in International Mathematics and Science Study (TIMSS) is an international study examining educational achievement in mathematics and science. So far, inclusive of the 2023 iteration, TIMSS has provided 28 years of trend data to support countries in making informed policy decisions. This report focuses mainly on presenting new findings related to environmental awareness from TIMSS 2023.

This chapter provides a brief introduction to TIMSS and a summary of the performance of Fourth Class and Second Year students in Ireland in mathematics and science in TIMSS 2023. Following this, an overview of environmental awareness as a concept in the wider literature and within TIMSS is provided, together with the policy context of environmental education in the Irish context.

What is TIMSS?

TIMSS is an international study that evaluates the mathematics and science knowledge and skills of students in Fourth Grade (Fourth Class in Ireland) and Eighth Grade (Second Year in Ireland) across participating countries. It provides both national and international comparative data to support policymakers and educators in making informed decisions. The study is directed by the TIMSS and PIRLS International Study Center at Boston College, USA and is managed by the International Association for the Evaluation of Educational Achievement (IEA), a non-profit consortium of research institutes. In Ireland, the Educational Research Centre (ERC) managed the country's participation in TIMSS 2023 on behalf of the Department of Education.

TIMSS is conducted every four years, with the first assessment taking place in 1995. TIMSS 2023 was the eighth cycle, with 65 participating countries (59 at Fourth Grade and 44 at Eighth Grade). Ireland has participated in five cycles of TIMSS: 1995, 2011 (at Fourth Grade only), 2015, 2019 and 2023. In the 2023 cycle, almost all participating countries, including Ireland, administered the test digitally.

TIMSS 2023 in Ireland: Summary of key findings

In general, students in Ireland achieved at a reasonably high level in TIMSS 2023, relative to other countries. At both grade levels, students in Ireland achieved mean mathematics and science scores that were significantly above the international averages.[1]

More specifically, Fourth Class pupils achieved a mean score of 546 in mathematics and 532 in science, with the international averages being 503 and 494, respectively. In Fourth Grade mathematics, seven countries achieved mean scores higher than Ireland's, while four countries achieved similar scores. The mean mathematics score of Fourth Class pupils in Ireland was significantly higher than the scores of 46 countries. In Fourth Grade science, ten countries achieved significantly higher mean scores than Ireland and eleven countries had similar mean scores, while 36 countries had significantly lower scores than Ireland.

Second Year students achieved a mean score of 522 in mathematics and 525 in science, with the international averages being 478 for both subjects. Their mathematics performance was significantly lower than that of five countries, similar to four countries, and significantly higher than 34 countries. In science, Second Year students'

1 Data are based on responses from 4750 Fourth Class pupils in 153 primary schools and 5090 Second Year students in 153 post-primary schools.

performance was significantly lower than that of four countries, similar to nine countries, and significantly higher than 30 countries.

The strong focus on trends in TIMSS allows analysis beyond within-cycle comparisons. Overall, performance in TIMSS in Ireland has remained stable in recent years at both grade levels and for both subjects, with no statistically significant changes in mean scores since 2015.

Overall, boys and girls in Fourth Class achieved similar scores in both mathematics and science in TIMSS 2023, with no significant differences on average. However, significant differences between boys and girls were seen at Second Year for both mathematics and science. In mathematics, Second Year boys' mean score (528) was 14 points higher than girls' (514); in science, boys' mean score (529) was nine points higher than girls' (520). These significant gender differences in TIMSS 2023 mark a change from 2019 and 2015, where no significant gender differences had been observed.

For a more detailed discussion of mathematics and science achievement in Ireland, and for details on the administration of TIMSS, readers are referred to the initial TIMSS 2023 national report (McHugh, Denner et al., 2024).

Environmental awareness, environmental education, and the policy context

Defining environmental awareness

The term *environmental awareness* is frequently used in both every day and academic contexts, yet it lacks a consistent, universally accepted definition, resulting in diverse interpretations (Cruz & Manata, 2020; Ham et al., 2016; Takács-Sánta, 2007). According to Ham et al. (2016), this conceptual ambiguity has led to the development of related terms such as *environmental consciousness* and *environmental concern*, each with its own nuances. In its broadest form, environmental awareness encompasses a range of factors, including perceptions, emotions, knowledge, attitudes, values, and behaviours regarding environmental issues (Bamberg, 2003). This comprehensive definition of environmental awareness aligns with the one adopted by TIMSS, as described further below.

Environmental education

The growing urgency of environmental issues has led to increased focus on integrating environmental education into school curricula across many countries, with the aim of equipping students with the knowledge, skills, and values necessary to address these pressing challenges (O'Malley & Pierce, 2023). For example, Hungerford and Volk (1990) described environmental education as a potential "silver bullet" for fostering knowledge, awareness, and attitudes that are vital for sustainable development. Subsequent studies support this idea, indicating that environmental education can positively influence pro-environmental behaviours by enhancing students' understanding of the complex relationships between humans and the environment (Edsand & Broich, 2020; Uitto et al., 2015). Research has also suggested that integrating sustainability into school practices, where students observe environmental responsibility being modelled, can enhance their attitudes and behaviours towards environmental stewardship (Mathar, 2015; Murphy et al., 2021).

However, while environmental education is a powerful tool, its ability to have a major impact on global environmental challenges or on the development of meaningful changes to long-term sustainability

practices remains a topic of ongoing debate (O'Malley & Pierce, 2023). This debate is further complicated by the recognition that factors such as gender and socioeconomic status may be linked with differences in environmental awareness. For instance, some studies have found that women tend to exhibit higher levels of environmental awareness than men (McCright, 2010; Xiao & McCright, 2015), and that individuals with greater access to resources generally demonstrate higher levels of environmental knowledge (Eom et al., 2018; Pampel, 2014). Additionally, research has found that students' environmental knowledge and responsible behaviours are associated not only with their attitudes towards science, but also with their educational contexts, including both home and school environments (Edsand & Broich, 2020; Hassan et al., 2010; Uitto et al., 2015). The increasing availability of cross-national comparative data on topics related to environmental education can be seen as reflecting both a growing interest in this topic, and as recognition of a growing need for relevant data to inform future policymaking (Isac et al., 2025).

Concerns have also been raised that highlight a need for clarity amidst the risk of conflating different goals that, in reality, relate to the environment and sustainability in quite distinct ways. For example, Vare and Scott (2007) distinguish between two types of education for sustainable development (ESD). The first, ESD 1, corresponds to a broadly scientific conception of environmental education that focuses on the promotion of knowledge and skills to accomplish specific defined goals. The second, ESD 2, represents a more critical perspective that seeks to explore the trade-offs and contradictions that can emerge in pursuit of sustainable living, including what it means for an advanced economy to become sustainable. Taking a global perspective, Osuntuyi and Lean (2022) highlight the complex interplay between education, economic growth, energy consumption, and environmental degradation in lower-income countries, but recommend that higher-income countries (such as Ireland) "should continue to embrace environmental education to improve environmental quality, as education may motivate individuals to utilize energy more efficiently" (p.9).

Environmental education within the Irish context

Although environmental education has not always been a central focus within the Irish education system (Derman & Gurbuz, 2018; O'Malley & Pierce, 2023), both primary and post-primary curricula now increasingly incorporate references to the environment, environmental sustainability, and environmental awareness, with these areas being increasingly recognised as essential for fostering responsible global citizenship.

At primary level, the current science curriculum addresses the environment within two key areas: social, environmental and scientific education (SESE), which includes history, geography, and science; and social, personal and health education (SPHE). While environmental care is mentioned in SPHE, it is more extensively explored within SESE, particularly in science and geography, with one of SESE's primary aims being "to foster a sense of responsibility for the long-term care of the environment and a commitment to promote the sustainable use of the Earth's resources through personal lifestyle and participation in collective environmental decision-making" (Department of Education and Science & National Council for Curriculum and Assessment [NCCA], 1999, p. 5). Environmental awareness and care features as a separate strand within science and geography across all grade levels of primary education, focusing on sustainability, the interdependence of living organisms, and the impact of human activities on the planet. This strand seeks to develop children's appreciation of their environment and to help them recognise their role in conservation and sustainability efforts. In addition, voluntary initiatives – such as the Green Schools programme (https://greenschoolsireland.org) that is supported by An Taisce and awards 'green flags' to schools that exhibit strong sustainability practices – are widespread in Ireland's primary schools.

At post-primary level, environmental awareness continues to be emphasised within the science curriculum primarily, although it also permeates other subjects such as Geography and Civic, Social and Political Education (NCCA and Department of Education and Skills, 2017, 2021) and other aspects of school life, such as Green

Schools.[2] At a high level, the overarching *Framework for Junior Cycle* (Department of Education and Skills, 2015, p.54) includes the aspiration that students will understand "the origins and impacts of social, economic, and environmental aspects of the world around her/him" and have "the awareness, knowledge, skills, values and motivation to live sustainably". The Junior Cycle science curriculum explicitly aims to "develop scientific literacy and apply this in cognitive, affective, and psychomotor dimensions to the analysis of science issues relevant to society, the environment, and sustainability" (NCCA & Department of Education and Skills, 2015, p.5). Junior Cycle science is organised into four content strands: Earth and Space, Chemical World, Physical World, and Biological World. Each strand incorporates four key elements – building blocks, systems and interactions, energy, and sustainability – with the inclusion of sustainability across these elements underscoring its importance within the curriculum. Specific learning outcomes related to sustainability are outlined in each strand. In Earth and Space, students are expected to explore how Earth processes and human actions influence climate and evaluate the effects of climate change. In the Chemical World, they are expected to assess human contributions to sustainability through resource extraction, use, disposal, and recycling. In Physical World, they are expected to explore the ethical and sustainability issues related to electricity generation and consumption while, in the Biological World, they are expected to explore conservation, biodiversity, and global food production. Through these topics, students have the opportunity to engage with critical environmental issues such as climate change, renewable energy, and biodiversity. Post-primary science teachers are tasked with fostering critical thinking, encouraging inquiry-based learning, and incorporating practical activities relating to these topics to enhance students' problem-solving skills.

The increasing emphasis on environmental education in Ireland is further reflected in the introduction of the Leaving Certificate *Climate Action and Sustainable Development* subject, which is set to be offered on a phased basis from September 2025. This new subject builds upon prior learning and aims to equip students with the knowledge and skills necessary to address sustainability challenges, particularly the climate crisis. It promotes critical thinking, problem-solving, and the application of scientific evidence, encouraging students to gain a deeper understanding of sustainability principles (NCCA, 2024a). At primary level, the *Primary Curriculum Framework* published in 2023 (Department of Education, 2023) includes Social and Environmental Education as one of five broad curriculum areas to be included in a redeveloped curriculum for all primary and special schools. This curriculum area is intended, in part, to help children "to develop an understanding of the human and natural environments and the relationship between them" and to "come to an understanding and appreciation of their inherent rights and responsibilities as custodians of this planet" (p.19).

In addition to curriculum developments, several national policies and initiatives have been introduced to support environmental education. A key document is the *National Strategy on Education for Sustainable Development*, first published in 2014 and updated in 2022 (Department of Education and Skills, 2014; Government of Ireland, 2022). This strategy guides efforts to integrate sustainability into the Irish education system across all levels of education and aligns closely with UNESCO's *Framework for Education for Sustainable Development 2030* (UNESCO, 2017, 2020). The 2022 Strategy focuses on five key priority action areas: advancing policy to support sustainable development; transforming learning environments; building educators' capacities; empowering young people to engage in sustainable behaviours; and accelerating local actions to implement sustainability practices. These interconnected priorities aim to create a holistic approach to education for sustainable development. Furthermore, the revised Leaving Certificate Biology, Leaving Certificate Chemistry, and Leaving Certificate Physics specifications identify Sustainability as one of three crosscutting themes which are intended to act as lenses through which students will explore the application of knowledge from biology, chemistry and physics.

2 As the post-primary students who participate in TIMSS are coming towards the end of Second Year at the time of the assessment, midway through the Junior Cycle, we focus here on that stage of education.

In 2018, the NCCA published *Education for Sustainable Development: A Study of Opportunities and Linkages in the Early Childhood, Primary and Post-Primary Curriculum* (NCCA, 2018). This study mapped the Irish curriculum frameworks against UNESCO's key competencies for sustainability and identified opportunities for incorporating the Sustainable Development Goals (SDGs) into the curriculum. It also confirmed that education for sustainable development was already embedded to some degree across all levels of education in Ireland, while it highlighted effective practices and provided recommendations for enhancing future curriculum reviews to further integrate sustainability principles. In a related vein, the Teaching Council's (2020) *Standards for Initial Teacher Education* specifies Education for Sustainable Development as a core element that should be included in any accredited initial teacher education programme.

On the whole, then, while environmental education has historically been underemphasised in Ireland, relative to other areas, recent policy developments and initiatives demonstrate a growing commitment to sustainability within the education system. Ongoing research remains crucial to assess the effectiveness of strategies or initiatives in enhancing environmental awareness and fostering responsible behaviours among students and educational stakeholders, particularly in the face of global environmental challenges. The analysis of TIMSS data on environmental awareness, presented in this report, offers valuable insights into these ongoing efforts.

Environmental awareness in TIMSS

As noted above, the global nature of environmental challenges has increasingly prompted policymakers to recognise individuals as key "agents of change" (Barr et al., 2011). This has, in turn, highlighted the need to assess individuals' attitudes towards the environment (Cruz & Manata, 2020; Lavelle & Fahy, 2016). In response to this need, an environmental knowledge scale was initially developed in TIMSS 2019, as a subscale of the science assessment, in an effort to understand students' awareness of the environment at a cross-national level (IEA, 2021; Martin & Mullis, 2021).

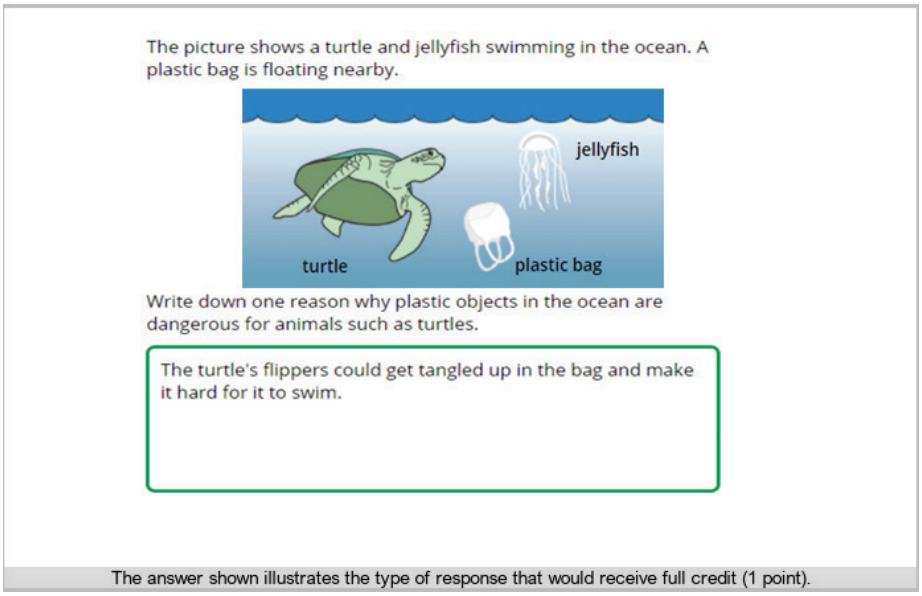
To further enhance coverage of environmental topics, TIMSS 2023 included an expanded range of relevant items. The TIMSS 2023 Assessment Framework for science specified three content domains for Fourth Grade science: life science, physical science, and earth science, and four content domains for Eighth Grade science: biology, chemistry, physics, and earth science. Environmental knowledge items in TIMSS 2023 were selected from the life science and earth science content domains at Fourth Grade, and from the biology and earth science domains at Eighth Grade. In total, the Fourth Grade environmental knowledge subscale included 44 items and the Eighth Grade scale included 58 items (von Davier et al., 2024).

Topics covered on the assessment of environmental knowledge included the use and conservation of nature's resources, the causes and consequences of pollution, the changes and impact on habitats of different climates, and various cycles in nature. As an illustration, Figures 1.1 to 1.4 show four items that were used in the TIMSS 2019 or TIMSS 2023 environmental knowledge assessments.[3] In these items, Fourth Grade pupils were questioned about the effects of plastic pollution in the oceans (Figure 1.1) and the types of natural resources that are needed to grow plants (Figure 1.2), while Eighth Grade students were asked about the impacts of farming on the surrounding environment (Figure 1.3) and about their understanding of solar energy production (Figure 1.4).

3 Permission to re-publish these items in this report was granted by the IEA.

Figure 1.1: Example of Fourth Grade environmental knowledge item from TIMSS 2019

Content Domain: Life Science
Cognitive Domain: Knowing
Description: States one reason why plastic objects in the ocean are dangerous for sea animals



Source: IEA's Trends in International Mathematics and Science Study – TIMSS 2019 Copyright © 2020 International Association for the Evaluation of Educational Achievement (IEA). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education and Human Development, Boston College.

Figure 1.2: Example of Fourth Grade environmental knowledge item from TIMSS 2023

Content Domain: Earth Science
Cognitive Domain: Knowing
Description: Identifies natural resources used to grow plants

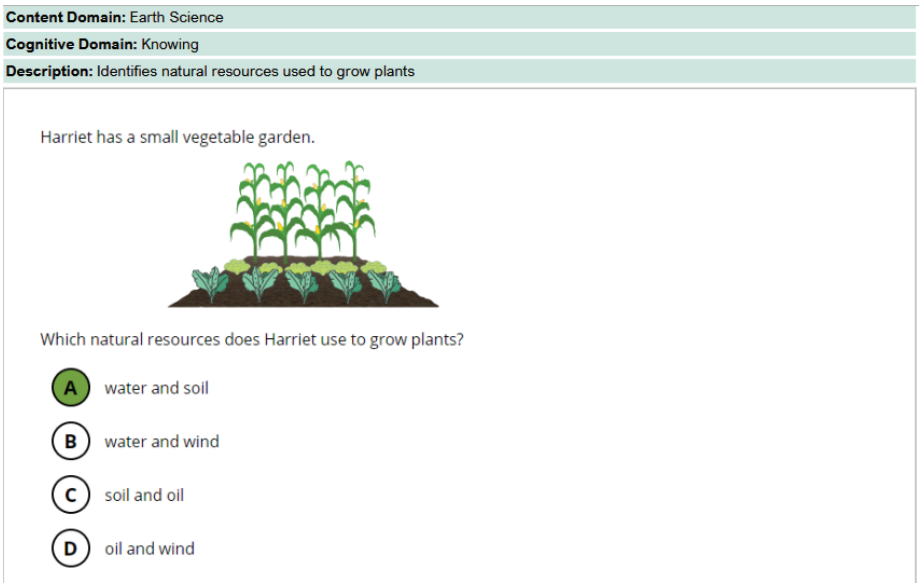


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Figure 1.3: Example of Eighth Grade environmental knowledge item from TIMSS 2019

Content Domain: Biology
Cognitive Domain: Applying
Description: Identifies what human activity can cause algal blooms

Algal blooms can occur in freshwater ponds when there are too many nutrients in the water. These blooms can be harmful to other wildlife.

The picture shows an algal bloom in a pond.

What human activity can cause too many nutrients to enter a pond and cause an algal bloom?

A farming with a lot of fertilizer
B burning chemicals in factories
C using aerosol spray cans
D planting lots of trees around a pond

The answer shown illustrates the type of response that would receive full credit (1 point).

Source: IEA's Trends in International Mathematics and Science Study – TIMSS 2019 Copyright © 2020 International Association for the Evaluation of Educational Achievement (IEA). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education and Human Development, Boston College.

Figure 1.4: Example of Eighth Grade environmental knowledge item from TIMSS 2023

Content Domain: Earth Science
Cognitive Domain: Knowing
Description: Disadvantage of solar energy

Which of the following is a **disadvantage** of using solar energy?

A The sun is a renewable energy source.
B Solar panels are not efficient in windy areas.
C Solar energy can be used in remote places where there are no power lines.
D Clouds affect the amount of energy produced by solar panels.

Source: IEA's Trends in International Mathematics and Science Study – TIMSS 2023 Copyright © 2024 International Association for the Evaluation of Educational Achievement (IEA). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education and Human Development, Boston College.

In addition to the environmental knowledge scale, TIMSS 2023 introduced a new range of questionnaire items relating to the environment aimed at students, parents/guardians (at Fourth Grade only), teachers, and school principals:

- The Student Questionnaire asked about students' attitudes towards environmental preservation, environmentally responsible behaviours, and the frequency with which they engage in these behaviours.
- The Home Questionnaire asked parents/guardians about topics such as how often they encourage their children to take action to protect the natural environment and how often they spend time in nature.
- The Teacher Questionnaire asked teachers about their engagement in environmental activities with students, the extent to which they consider that education about environmental sustainability should be a priority, and about professional development related to environmentalism and sustainability.
- Similarly, the School Questionnaire asked principals about their schools' emphasis on environmental sustainability.

Taken together, these ***environmental attitudes***, combined with the ***environmental knowledge*** of students, provide a comprehensive measure of what TIMSS defines holistically as **environmental awareness:**

Environmental awareness	**=**	**Environmental knowledge**	**+**	**Environmental attitudes**

Structure of this report

The remainder of this report is structured as follows: Chapters 2 and 3 focus on describing the environmental knowledge of students in Fourth Class and Second Year, respectively. Chapter 4 describes students' attitudes towards environmental preservation. Chapters 5 and 6 describe environmental attitudes and behaviours in the home and at school, respectively. Finally, Chapter 7 provides a summary and discussion of the key findings arising from the analysis.

How to interpret the analyses in this report

The following notes can be used to interpret the results reported in the following chapters.

Achievement scores

Estimates of student achievement in environmental knowledge are reported on a scale that is set to an international centrepoint of 500 with a standard deviation of 100.

Measures of uncertainty

Estimates of achievement are prone to uncertainty arising from sampling and measurement error. To quantify this error, when a mean achievement score or percentage is estimated for a group (e.g., for all students in Ireland), this value is accompanied by a standard error (SE). The SE is a gauge of the level of uncertainty around

the mean estimate. The smaller the SE, the more confident we can be that the observed value is likely to reflect that of the population. Conversely, larger SEs indicate more uncertainty around the mean estimate.

A 95% confidence interval (CI) is a range of values such that there is a 95% probability that the true population score lies within this interval. We can create 95% CIs around a mean achievement score by (i) multiplying our estimated SE by 1.96, and (ii) adding this amount to, and subtracting it from, the mean score. Often – although not always – if the CIs around two sets of means overlap, it indicates that the difference between the two means is not statistically significant. Conversely, if two CIs do not overlap, that indicates a statistically significant difference in means.

Statistical significance

A difference between groups is considered statistically significant if we can be confident that it is unlikely to have occurred by chance. In this report, statistical significance tests are reported at the 95% confidence level and measurement and sampling error are accounted for in the statistical comparisons. Where reference is made to a *significant difference* (i.e., *significantly lower* or *significantly higher*) in this report, a test of statistical significance has been conducted.

Readers should note that a statistically significant difference does not necessarily imply that a difference is substantive or meaningful in terms of its implications for policy or practice. To assist in interpreting outcomes related to student achievement, effect sizes associated with the magnitude of differences observed are also provided (see below).

Effect sizes

Effect sizes provide a standardised way to compare the magnitude of differences or relationships between two variables. In this report, Pearson's *r* is used as the effect size to describe the strength of the relationship between two continuous variables (see below), and Hedges' *g* is used to describe the magnitude of differences in mean achievement scores between two or more groups of students. Hedges' *g* is a modified version of another well-known effect size, Cohen's *d*, that is more suitable for use when sample sizes in the groups being compared are very different (as is sometimes the case in this report), while estimates of *g* and *d* are very similar when sample sizes are more closely matched.

Guidelines on labelling effect sizes are available but should be interpreted cautiously and with due recognition of the local context, as it is increasingly recognised that the effect sizes associated with interventions in education tend to be smaller in practice (Evans & Yuan, 2022; Kraft, 2020) than might be expected based on older guidelines (e.g., Cohen, 1988). As a loose rule of thumb, the USA's What Works Clearinghouse has previously described effect sizes of .25 or higher as "substantively important" (2014, p.23) and the UK's Education Endowment Foundation describes effects from interventions ranging from .19-.44 as "moderate", from .45-.69 as "high", and from .70 upwards as "very high" (Coe & Kime, 2013, p.18). Cohen's (1988) descriptors remain widely used and refer to an effect size of 0.2 for mean differences as small, 0.5 as medium, and 0.8 as large.

Correlations

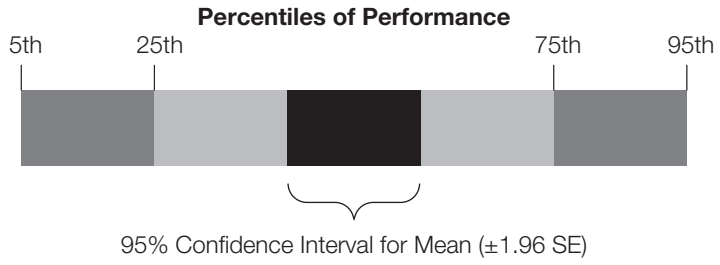
A correlation coefficient describes the strength of the linear relationship between two variables. Correlations are reported on a range from 0 to 1, with 0 representing no relationship between two variables and values approaching 1 (or -1) representing a very strong relationship. A positive correlation indicates that as one variable increases, so does the other, while a negative correlation indicates that one variable decreases in magnitude as the other increases.

Percentiles of performance

Student performance in environmental knowledge can also be examined using percentiles, which can be interpreted as indicating that *a student at the Xth percentile of a given group performed as well as or better than X% of the students in that group.* For example, a student at the 20th percentile achieved a mean score at least as high or higher than 20% of their peers. Students at the 5th percentile of a group are among the lowest-achieving students in that group, while those at the 95th percentile are among the highest-achieving students.

In this report, the distributions of performance are presented graphically in a format similar to that shown in Figure 1.5. The black band in the middle of each distribution represents the 95% CI around the mean achievement score, taking into account sampling and measurement error. The light grey band on the left represents the range of achievement from the 25th percentile to the lower limit of the CI, while the light grey band on the right represents the range from the upper limit of the CI to the 75th percentile. The dark grey bands at either end of the distribution represent the range from the 5th to the 25th percentile (left) and from the 75th to the 95th percentile (right).

Figure 1.5: Format used in this report to present percentiles of performance



Chapter 2:
Environmental knowledge in Fourth Class

This chapter outlines Fourth Grade pupils' performance in the environmental knowledge subscale that was administered as part of the TIMSS 2023 science assessment. The chapter is organised into five sections. The first section examines the overall results of pupils in Ireland and internationally in environmental knowledge. The second section presents the distribution of environmental knowledge achievement in Ireland and in selected reference countries.[4] The third section focuses on gender differences in achievement for Ireland and the selected reference countries. The fourth section shows achievement differences by school DEIS status in Ireland. Finally, the fifth section shows the differences in achievement between socioeconomic status (SES) categories in Ireland and selected reference countries.

Overall results

The mean environmental knowledge scores of Fourth Grade pupils in Ireland, along with all other participating countries and benchmarking participants, are presented in Table 2.1.

In Ireland, Fourth Class pupils achieved a mean score of 536 in environmental knowledge, which was significantly higher than their mean score in overall science (by four points). Ireland's environmental knowledge score was also significantly above the TIMSS 2023 international average (496).

Pupils in seven countries scored significantly higher in environmental knowledge than pupils in Ireland: Singapore, the Republic of Korea, Chinese Taipei, Poland, England, Türkiye and Australia. Pupils in 10 countries achieved a statistically similar score to Ireland: Hong Kong, Finland, Japan, Denmark, the United States, Norway, Hungary, Bulgaria, Macao and Sweden. Pupils in the remaining 39 countries with available data scored significantly lower than pupils in Ireland, including in Canada, New Zealand, Germany and France.

Including Ireland, 21 European Union (EU) countries participated in TIMSS 2023 at Fourth Grade. Of these EU countries, only Poland scored significantly higher than Ireland in environmental knowledge. Five EU countries did not have significantly different scores to Ireland (Finland, Denmark, Hungary, Bulgaria and Sweden). The remaining EU countries scored significantly lower than pupils in Ireland (for example: Lithuania, Germany, Spain and France).

The three countries that achieved the highest mean scores in environmental knowledge are Singapore (577), the Republic of Korea (575) and Chinese Taipei (566). These three countries also achieved the highest mean scores in overall Fourth Grade science (see McHugh, Denner et al., 2024). However, all three scored significantly lower in environmental knowledge than in overall science (Table 2.1). Of all the countries that participated at Fourth Grade, Singapore had the largest difference in score between environmental knowledge and overall science, with a score for environmental knowledge that was 30 points lower than their overall science score. Kuwait had the largest relative advantage in environmental knowledge, scoring 15 points higher in environmental knowledge compared to overall science, with this difference being statistically significant. Overall, 13 countries scored significantly better in environmental knowledge than in science (including Ireland), 25 countries had similar scores for environmental knowledge and science, and 19 scored significantly lower in environmental knowledge than in science.

4 The countries used as comparators in this report are the same as those presented for comparison of mathematics and science achievement outcomes by McHugh, Denner et al. (2024).

Table 2.1 also presents the standard deviation (spread) around each mean score. In Ireland, the standard deviation for Fourth Class environmental knowledge was 92 score points, which was similar to the standard deviation of the TIMSS 2023 international average (94). Internationally, Kuwait had the largest standard deviation at 129 score points, while the Netherlands had the lowest standard deviation at 73 score points.

Table 2.1: Mean achievement scores of countries and benchmarking participants, Fourth Grade environmental knowledge

Country	Mean	(SE)	SD	Difference from Overall Science	
Singapore	577	(4.0)	102	-30	▼
Korea, Rep. of	575	(3.6)	89	-8	▼
Chinese Taipei	566	(2.4)	86	-6	▼
Poland	557	(2.5)	78	+7	▲
England	557	(3.2)	91	+1	
Türkiye (G5)	553	(3.9)	102	-18	▼
Australia	550	(3.0)	90	+1	
Hong Kong SAR	543	(3.7)	102	-2	
Finland	542	(3.4)	89	0	
Japan	541	(3.4)	77	-13	▼
Ireland	**536**	**(3.9)**	**92**	**+4**	▲
Denmark	536	(3.0)	82	+14	▲
United States	535	(3.2)	102	+3	▲
Norway (G5)	535	(2.8)	84	+5	
Hungary	534	(3.8)	93	+10	▲
Bulgaria	532	(5.7)	118	+3	
Macao SAR	528	(1.6)	87	-8	▼
Sweden	526	(3.6)	87	-6	▼
Canada	524	(2.2)	80	+3	
Lithuania	521	(3.3)	85	-16	▼
Romania	521	(5.3)	93	-6	
Slovenia	520	(3.2)	83	-5	▼
Czech Republic	519	(3.1)	79	-6	▼
Portugal	519	(3.6)	89	+8	▲
Netherlands	518	(2.3)	73	+1	
New Zealand	518	(2.8)	97	+1	
Italy	517	(2.7)	79	+7	▲
Serbia	517	(3.3)	86	+7	▲
Germany	513	(2.8)	91	-2	
Spain	510	(2.7)	81	+6	▲
Slovak Republic	509	(4.4)	96	-12	▼
Latvia	503	(3.4)	84	-22	▼
France	496	(3.6)	90	+8	▲

Country	Mean	(SE)	SD	Difference from Overall Science	
TIMSS International Average	**496**	**(0.5)**	**94**	**+1**	
United Arab Emirates	494	(1.8)	122	-1	
Belgium (Flemish)	489	(3.8)	77	0	
Chile	484	(2.9)	86	+5	▲
Albania	483	(5.4)	96	-8	▼
Belgium (French)	481	(2.8)	89	0	
Cyprus	480	(3.1)	90	-7	▼
Bahrain	474	(4.1)	110	-1	
Montenegro	466	(2.5)	93	+5	▲
Armenia	465	(4.8)	95	+8	
Qatar	464	(4.1)	108	-8	▼
Georgia	459	(4.7)	84	-5	
Kazakhstan	456	(4.2)	106	-11	▼
Bosnia and Herzegovina	446	(4.3)	92	-2	
North Macedonia	435	(4.5)	101	-4	
Saudi Arabia	428	(4.1)	96	+1	
Iran, Islamic Rep.	427	(5.2)	118	-5	
Brazil	425	(4.8)	114	0	
Oman	424	(4.3)	106	-8	▼
Uzbekistan	416	(3.2)	85	+4	
Azerbaijan, Rep. of	410	(4.0)	98	-11	▼
Jordan	410	(5.2)	109	-8	▼
Kosovo	400	(3.7)	82	-3	
Morocco	392	(6.1)	126	+2	
Kuwait	389	(5.7)	129	+15	▲
South Africa (G5)	-	-	-	-	
Benchmarking Participants					
Dubai, UAE	*565*	*(1.9)*	*98*	*+3*	▲
Ontario, Canada	*533*	*(3.5)*	*79*	*+8*	▲
Quebec, Canada	*504*	*(3.0)*	*75*	*-4*	
Sharjah, UAE	*499*	*(4.4)*	*107*	*-4*	
Abu Dhabi, UAE	*443*	*(2.9)*	*127*	*-3*	▼

Environmental knowledge mean significantly higher than Ireland

Environmental knowledge mean significantly lower than Ireland

Note. Norway, Türkiye, and South Africa assessed pupils in Fifth Grade rather than Fourth Grade.

The average achievement for South Africa was not reliably measured because the percentage of students with achievement too low for estimation exceeded 25%.

Multiple comparisons are not taken into account when testing significant differences.

The "Difference from overall science" column presents the difference between a country's environmental knowledge and science scores and indicates where statistically significant differences are observed. Significant differences in favour of environmental knowledge are indicated with up arrows; significant differences in favour of science are indicated with down arrows.

Source: Adapted from Exhibit 7.1.3 in von Davier et al. (2024).

Distribution of achievement

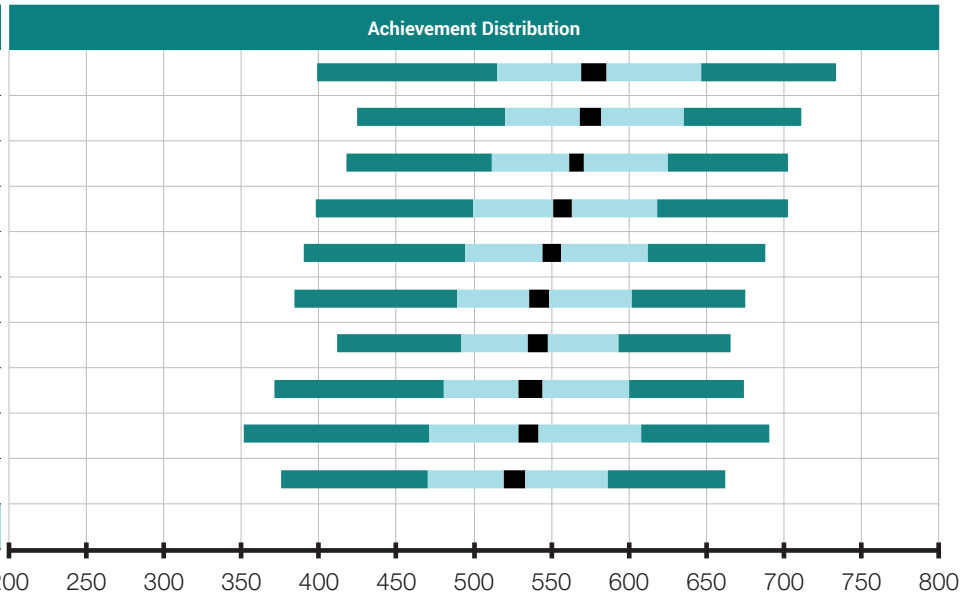
Figure 2.1 shows the distribution of environmental knowledge achievement for pupils in Fourth Grade who participated in TIMSS 2023 in Ireland and the selected reference countries. The range in the distribution indicates the difference between students at the 5th and 95th percentiles, which are the markers used here to represent the lowest- and highest-achieving pupils, respectively, in each country. Amongst the selected reference countries, the United States had the largest range in distribution (339 points), while Japan had the smallest range (254 points). Ireland's range in distribution falls roughly in the middle of the selected reference countries, at 302 points. The countries closest in range to Ireland are England (304 points) and Australia (298 points).

At the 5th percentile (the lowest-achieving pupils), pupils in Ireland achieved an environmental knowledge score of 372. Of the selected countries, only pupils in the United States achieved a lower mean score at the 5th percentile (352). Pupils in Sweden achieved a similar score to Ireland (375), while pupils in all other selected reference countries achieved a higher mean score at the 5th percentile. Pupils in the Republic of Korea achieved the highest score amongst the selected reference countries at this percentile (425), followed by Chinese Taipei (418). Despite having the highest mean score in environmental knowledge overall, pupils in Singapore achieved the third highest score at the 5th percentile, at 398 points. This was matched by pupils in England who also scored 398 at the 5th percentile.

At the 95th percentile (the highest-achieving pupils), pupils in Ireland achieved a score of 674. This is higher than two of the selected countries, Japan (666) and Sweden (662), and similar to the achievement of pupils in Finland (675).

Figure 2.1: Distribution of achievement in Ireland and selected reference countries, Fourth Grade environmental knowledge

Country	Mean	(SE)
Singapore	577	(4.0)
Korea, Rep. of	575	(3.6)
Chinese Taipei	566	(2.4)
England	557	(3.2)
Australia	550	(3.0)
Finland	542	(3.4)
Japan	541	(3.4)
Ireland	**536**	**(3.9)**
United States	535	(3.2)
Sweden	526	(3.6)
TIMSS Scale Centrepoint	**500**	



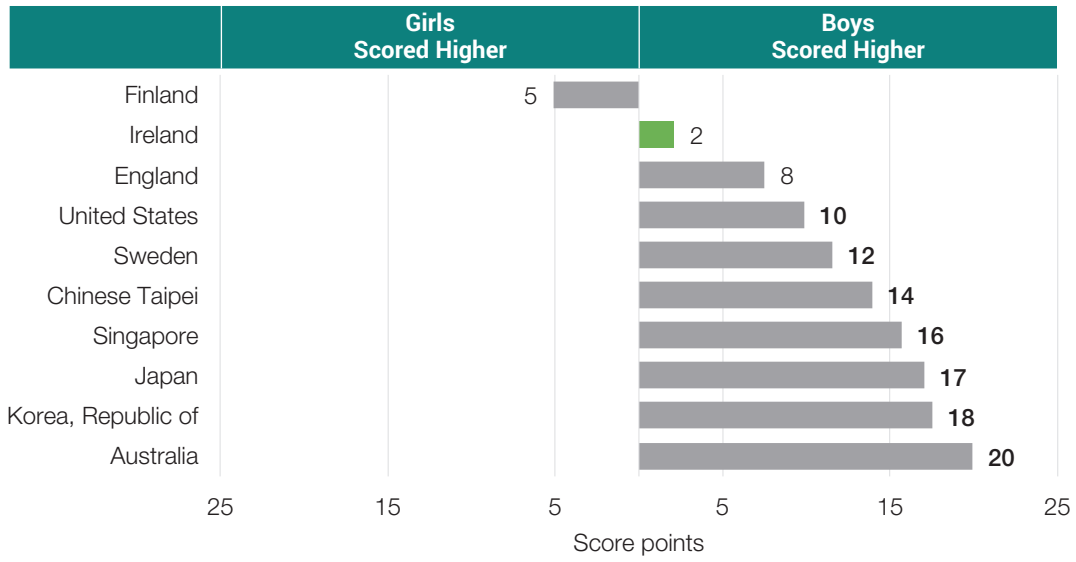
Achievement differences by gender

Figure 2.2 presents the difference in mean environmental knowledge achievement between Fourth Grade girls and boys in Ireland and selected reference countries. In Ireland, girls achieved a mean score of 535 and boys achieved a mean score of 537, resulting in a non-significant difference of two score points.

In most of the selected reference countries, boys scored higher than girls, with differences ranging from two score points in Ireland to 20 score points in Australia. The magnitude of the difference in Ireland was very small (*g*=.02). Of the selected countries, only Finland showed a difference in favour of girls (though this difference was not statistically significant). The difference in favour of boys was statistically significant in the United States, Sweden, Chinese Taipei, Singapore, Japan, the Republic of Korea, and Australia.

Gender differences in environmental knowledge were generally observed in countries that also showed gender differences in science achievement (von Davier et al., 2024), but not always. Among the comparison countries, pupils in Finland showed no significant gender difference in environmental knowledge even though a significant difference in science (in favour of girls) was observed. In contrast, Sweden has no gender difference in science but a significant gender difference in environmental knowledge scores.

Figure 2.2: Difference in mean achievement score between girls and boys for Ireland and selected reference countries, Fourth Grade environmental knowledge



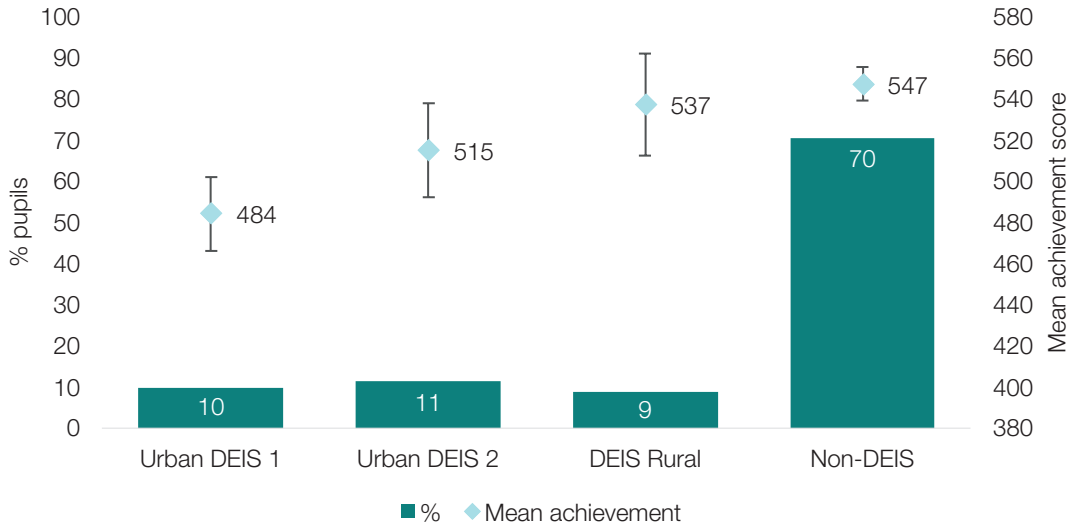
Note. Figures in **bold** indicate a significant difference between girls and boys.

Achievement differences by school DEIS status

Figure 2.3 presents the percentages of Fourth Class pupils that participated in TIMSS 2023 attending schools in each DEIS category. It also shows estimates of mean environmental knowledge achievement for each DEIS category and confidence intervals around these estimates. In total, 70% of participating pupils attended non-DEIS schools, 9% attended DEIS Rural schools, 10% attended DEIS Urban Band 1 schools, and 11% attended DEIS Urban Band 2 schools.

Pupils attending non-DEIS schools achieved a mean environmental knowledge score of 547. Pupils in Urban Band 1 schools achieved a mean score of 484, while those in Urban Band 2 schools achieved a mean score of 515. The score achieved by pupils attending Urban Band 1 and Band 2 schools was significantly lower than the score of pupils in non-DEIS schools. In substantive terms, the magnitude of the differences between non-DEIS and Urban Band 1 (*g*=.71) schools is particularly large, while the difference between non-DEIS and Urban Band 2 schools (*g*=.37) is also noteworthy. On the other hand, the difference between the score of pupils in DEIS Rural schools (537) and that of pupils attending non-DEIS schools was not significantly different and associated with a smaller effect size (*g*=.11). Caution must be taken when interpreting these differences, however, due to the relatively small sample sizes in each of the three DEIS categories (represented in Figure 2.3 by the width of the associated confidence interval).

Figure 2.3: Percentages and mean achievement of pupils in Ireland by school DEIS category, Fourth Class environmental knowledge



Note. Mean scores are presented with a 95% confidence interval around the estimate.

Achievement differences by pupils' socioeconomic status

Table 2.2 presents the percentages of pupils in each category of the international SES index and the mean achievement in environmental knowledge for each category in Ireland and selected reference countries.

The TIMSS SES index is a measure of socioeconomic status for each individual pupil that was introduced in TIMSS 2023 at Fourth Grade. It is based on parents' reports of these SES indicators: the number of books and children's books in the home, the parents' occupation and the parents' level of education. As a result of these reports, pupils were classified into *higher SES, middle SES* or *lower SES* groups. This scale has an international centrepoint of 10.0 and a standard deviation of 2.0 (von Davier et al., 2024).

In Ireland, pupils in the *higher SES* category achieved an environmental knowledge mean score of 567. This is significantly higher than those of pupils in the *middle SES* and *lower SES* categories (522 and 461, respectively). The effect sizes associated with the differences between *higher SES* and *middle SES* pupils (*g*=.53) and *higher SES* and *lower SES* pupils (*g*=1.26) were intermediate to large. In all the reference countries, a similar pattern

was observed whereby pupils in the *higher SES* category scored significantly higher than pupils in the other two categories.

Internationally, the difference between the environmental knowledge mean score of pupils in the *higher SES* category and the environmental knowledge mean score of pupils in the *middle SES* category was 48 points. The difference between pupils in the *higher SES* category and those in the *lower SES* category was 96 points. In Ireland, the differences between these categories were similar to the international differences (45 points and 106 points, respectively).

Of the selected reference countries, three had relatively similar gaps between the *higher SES* and *middle SES* categories to Ireland: Chinese Taipei at 47 points, Finland at 48 points and Japan at 46 points. The remaining three reference countries for which data on SES were available had larger differences between the *higher* and *middle* categories than Ireland. For the difference between the *higher SES* and *lower SES* categories, three of the selected reference countries had larger differences than Ireland (Singapore at 139 points, the Republic of Korea at 107 points, and Sweden at 115 points), while three had similar or smaller differences (Chinese Taipei at 96 points, Finland at 96 points, and Japan at 85 points).

Table 2.2: Percentages and mean achievement of pupils by Socioeconomic Status (SES) scale in Ireland and selected reference countries, Fourth Grade environmental knowledge

	Overall Mean	Higher SES		Middle SES		Lower SES	
		%	Mean	%	Mean	%	Mean
Singapore	577	54	624	43	557	4	485
Korea, Rep. of	575	65	597	32	543	3	490
Chinese Taipei	566	37	604	50	556	14	507
England	557	-	-	-	-	-	-
Australia	550	-	-	-	-	-	-
Finland	542	51	574	44	526	6	477
Japan	541	25	582	62	535	13	496
Ireland	**536**	**50**	**567**	**42**	**522**	**7**	**461**
United States	535	-	-	-	-	-	-
Sweden	526	55	565	39	502	6	449

Note. Data are not available for England, Australia or the United States as they did not administer the Home Questionnaire in TIMSS 2023.

Chapter 3:
Environmental knowledge in Second Year

In this chapter, Eighth Grade students' performance in the environmental knowledge content subscale is presented. Section one focuses on the overall environmental knowledge results for students in Ireland and internationally. Section two examines the distribution of achievement in environmental knowledge of students in Ireland and selected reference countries. Section three presents gender differences in environmental knowledge for students in Ireland and selected reference countries. Section four presents achievement differences between DEIS and non-DEIS schools in Ireland. Finally, section five shows the achievement differences between home educational resources status in Ireland and selected reference countries.

Overall results

Table 3.1 presents the mean environmental knowledge achievement of Eighth Grade students in Ireland and the other countries and benchmarking participants in TIMSS 2023.

Students in Ireland achieved a mean environmental knowledge score of 529, significantly higher than their mean score in overall science by four points and significantly higher than the TIMSS 2023 international average (475). Students in four countries achieved significantly higher mean scores than Ireland: Singapore, Chinese Taipei, Japan and the Republic of Korea. Students in six countries did not score significantly higher or lower than students in Ireland: Finland, Sweden, Hong Kong, England, Türkiye and Australia. Students in 32 countries scored significantly lower than students in Ireland, including Portugal, the United States and France.

Including Ireland, 13 EU countries participated in TIMSS 2023 at Eighth Grade. No EU country scored significantly higher than Ireland in environmental knowledge. Students in two EU countries, Finland and Sweden, achieved statistically similar scores to students in Ireland. Students in 11 EU countries achieved significantly lower scores than Ireland in environmental knowledge: Portugal, Hungary, Czech Republic, Lithuania, Italy, Norway, Austria, Malta, France, Cyprus and Romania.

Students in Singapore achieved the highest mean environmental knowledge score internationally (593), followed by Chinese Taipei (553) and Japan (549). These three countries also achieved the highest mean overall science score at Eighth Grade (McHugh, Denner et al., 2024). Comparing the performance of the top three performing countries on environmental knowledge and on overall science, each of these scored significantly lower on environmental knowledge than on science overall.

The Palestinian National Authority had the largest difference for environmental knowledge compared to overall science (-28 points). Portugal and Norway had the largest difference in favour of environmental knowledge compared to overall science (+14). Of all the participating countries, 10 scored significantly higher in environmental knowledge compared to overall science (including Ireland), 17 did not score significantly higher or lower, and 16 scored significantly lower in environmental knowledge compared to overall science.

Finally, Table 3.1 shows the standard deviation (spread) around the mean score for each country. In Ireland, the standard deviation for environmental knowledge at Eighth Grade was 92 score points. Internationally, South Africa reported the largest standard deviation (117 score points), while Azerbaijan reported the smallest (80 score points).

Table 3.1: Mean achievement scores of countries and benchmarking participants, Eighth Grade environmental knowledge

Country	Mean	(SE)	SD	Difference from Overall Science	
Singapore	593	(5.9)	101	-13	▼
Chinese Taipei	553	(2.5)	93	-19	▼
Japan	549	(3.2)	82	-8	▼
Korea, Rep. of	547	(3.2)	95	+1	
Finland	534	(2.9)	101	+3	▲
Sweden	534	(3.8)	114	+12	▲
Hong Kong SAR	532	(5.1)	102	+4	▲
England	530	(4.2)	101	-1	
Ireland	**529**	**(3.6)**	**92**	**+4**	▲
Türkiye	525	(3.4)	98	-4	
Portugal	520	(2.9)	89	+14	▲
Australia	519	(3.6)	101	-1	
Hungary	518	(3.7)	92	-3	
Czech Republic	517	(2.1)	83	-10	▼
United States	516	(4.2)	105	+3	▲
Lithuania	509	(3.1)	91	-11	▼
Italy	504	(3.8)	93	+3	
Norway	503	(2.9)	97	+14	▲
Austria	501	(3.3)	100	-11	▼
Malta	494	(1.5)	107	-7	▼
France	492	(3.6)	94	+6	
Israel	478	(3.9)	106	-2	
Qatar	476	(4.3)	108	-5	▼
United Arab Emirates	475	(2.1)	116	-11	▼
TIMSS International Average	**475**	**(0.6)**	**98**	**-4**	
Cyprus	465	(3.5)	95	+1	
Chile	459	(3.5)	93	+4	
Romania	457	(4.3)	93	-9	▼
Oman	448	(2.7)	98	-7	▲
Bahrain	441	(2.5)	110	-11	▼
Georgia	436	(3.2)	87	-11	▼
Kazakhstan	436	(2.9)	86	-6	▼
Malaysia	428	(4.1)	97	+1	
Brazil	423	(2.9)	98	+3	▲
Kuwait	418	(6.0)	109	-1	
Azerbaijan	408	(3.1)	80	-3	
Jordan	408	(3.5)	102	-5	
Saudi Arabia	407	(3.7)	103	-12	▼
Iran, Islamic Rep.	406	(4.7)	111	-13	▼
Uzbekistan	389	(3.5)	81	-7	
Palestinian National Auth.	365	(3.1)	101	-28	▼
South Africa (G9)	359	(4.4)	117	-3	
Morocco	331	(3.0)	89	+4	▲
New Zealand	503	(4.1)	103	+1	
Cote d'Ivoire	-	-	-	-	
Benchmarking Participants					
Dubai, UAE	*536*	*(3.2)*	*103*	*-11*	▼
Sharjah, UAE	*485*	*(4.7)*	*100*	*-13*	▼
Abu Dhabi, UAE	*435*	*(3.8)*	*121*	*-8*	▼

Environmental knowledge mean significantly higher than Ireland

Environmental knowledge mean significantly lower than Ireland

Note. New Zealand and Cote d'Ivoire are not included in the TIMSS 2023 International Average.
Norway and South Africa assessed students in Ninth Grade rather than Eighth Grade.
Multiple comparisons are not taken into account when testing significant differences.
The "Difference from overall science" column presents the difference between a country's environmental knowledge and science scores and indicates where statistically significant differences are observed. Significant differences in favour of environmental knowledge are indicated with up arrows; significant differences in favour of science are indicated with down arrows.
Source: Adapted from Exhibit 7.1.4 in von Davier et al. (2024).

Distribution of achievement

Figure 3.1 shows the distribution of achievement in Eighth Grade environmental knowledge for TIMSS 2023 in Ireland and selected reference countries. The range in distribution indicates the difference between students at the 5th and 95th percentiles (the markers used here to indicate the highest- and lowest-achieving students, respectively).

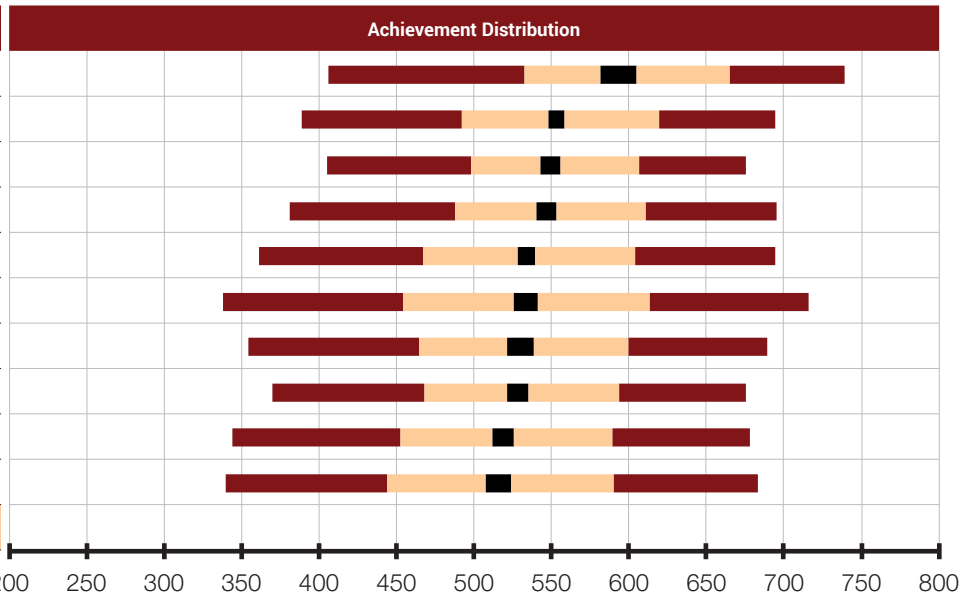
Of the countries included here, Sweden reported the largest range in distribution between the 5th and 95th percentiles (378 points) and Japan reported the smallest (271 points). The range reported by Ireland was relatively small compared to the selected reference countries (306 points) with only Japan reporting a smaller range. Chinese Taipei reported a similar range of distribution to Ireland (306 points).

Students at the 5th percentile in Ireland achieved a score of 370. Of the selected reference countries, four achieved higher scores than Ireland at the 5th percentile: Singapore, Chinese Taipei, Japan and the Republic of Korea. The other five selected reference countries achieved lower scores, with Finland achieving the closest score to Ireland (361). Singapore (406) and Japan (405) achieved the highest scores at the 5th percentile. Sweden (338) and the United States (340) achieved the lowest mean scores at the 5th percentile.

Students at the 95th percentile in Ireland achieved a score of 676. This was among the lowest scores for higher-achieving students in the selected reference countries, along with Japan (676), Australia (678), and the United States (683). As at the 5th percentile, students in Singapore achieved the highest mean score at the 95th percentile (739). Higher-achieving students in Sweden achieved the second highest score amongst the selected reference countries (716).

Figure 3.1: Distribution of achievement in Ireland and selected countries, Eighth Grade environmental knowledge

Country	Mean	(SE)
Singapore	593	(5.9)
Chinese Taipei	553	(2.5)
Japan	549	(3.2)
Korea, Rep. of	547	(3.2)
Finland	534	(2.9)
Sweden	534	(3.8)
England	530	(4.2)
Ireland	**529**	**(3.6)**
Australia	519	(3.6)
United States	516	(4.2)
TIMSS Scale Centrepoint	**500**	



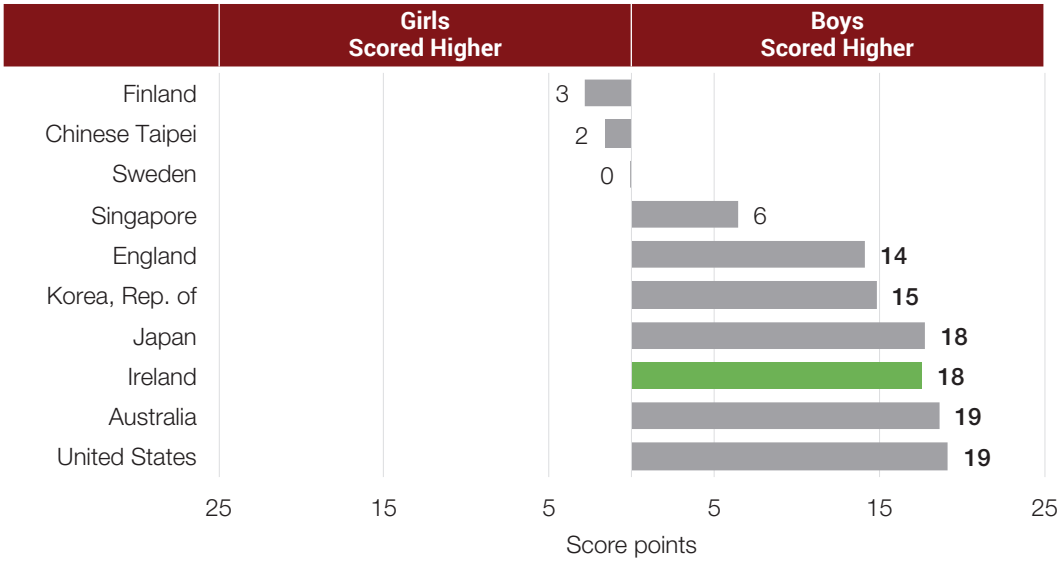
Achievement differences by gender

Figure 3.2 shows the difference between Eighth Grade boys and girls in mean environmental knowledge achievement for TIMSS 2023 in Ireland and selected reference countries. In Ireland, boys achieved a mean score of 537 and girls achieved a mean score of 519. This is a statistically significant difference of 18 score points in environmental knowledge in favour of boys in Second Year, which can be considered a small difference (*g*=.19).

Boys significantly outperformed girls in about half of the selected reference countries, ranging from a 14 score point difference in England to a 19 score point difference in the United States. The remaining four selected reference countries had no significant differences between the achievement of boys and girls on environmental knowledge.

Gender differences in environmental knowledge generally tended to correspond to gender differences in science achievement (von Davier et al., 2024), albeit with some exceptions. Finland showed no significant gender difference in environmental knowledge but a significant difference in science was observed, while the Republic of Korea exhibited the opposite pattern.

Figure 3.2: Difference in mean achievement score between girls and boys for Ireland and selected countries, Eighth Grade environmental knowledge

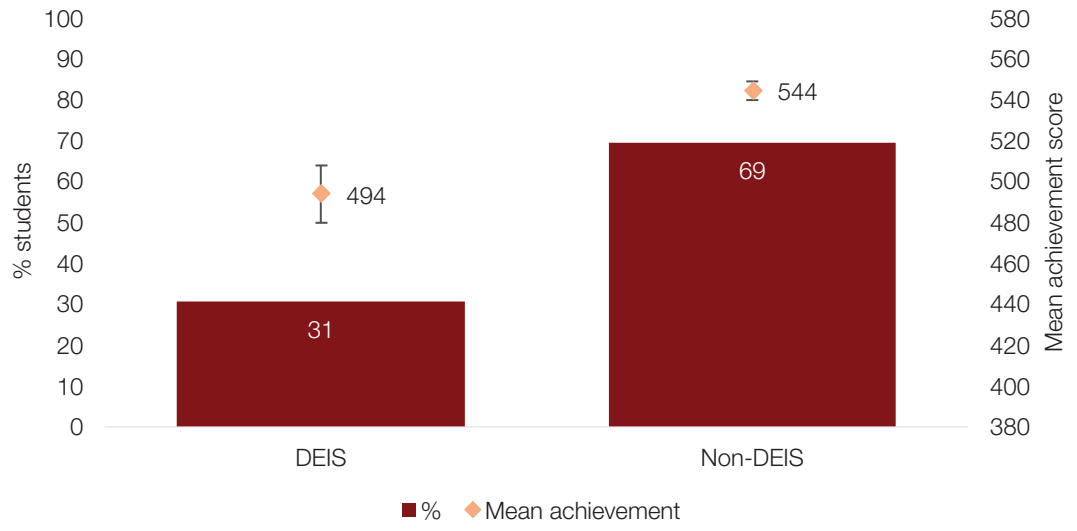


Note. Figures in **bold** indicate a significant difference between girls and boys.

Achievement differences by school DEIS status

Figure 3.3 shows the percentage of students at Second Year attending DEIS and non-DEIS schools, estimates of the mean environmental knowledge achievement, and confidence intervals around each estimate. Overall, 31% of Second Year students attended DEIS schools and 69% attended non-DEIS schools. Students attending DEIS schools achieved a mean score of 494 for environmental knowledge while students attending non-DEIS schools achieved a significantly higher mean score of 544, representing an intermediate difference in environmental knowledge between the two groups (*g*=.56).

Figure 3.3: Percentages and mean achievement of students in Ireland by school DEIS category, Second Year environmental knowledge



Note. Mean scores are presented with a 95% confidence interval around the estimate.

Achievement differences by students' Home Educational Resources

Table 3.2 shows the percentage of students in each category of the international home educational resources (HER) index and the mean achievement in educational knowledge for students in Ireland and selected reference countries. The HER index is based on Eighth Grade students' reports about the number of books, number of home study supports, and the highest level of education achieved by either parent or guardian. It has an international centrepoint of 10.0 and a standard deviation of 2.0 (von Davier et al., 2024).

Students in Ireland with *many resources* achieved a mean environmental knowledge score of 570, significantly higher than that of students with *some resources* (520) or *few resources* (465). The associated effect sizes were intermediate to large, at *g*=.61 and *g*=1.28, respectively. Similarly, among the reference countries, students with *many resources* achieved scores significantly higher than students with *some resources* or *few resources*.

Internationally, the difference in mean score achieved by students with *many resources* and those with *some resources* was 47 points, while the difference in mean score between students with *many resources* and *few resources* was 96 points. In Ireland, the difference between the *many resources* and *some resources* categories was similar to the international difference (51 points), while the difference between *many resources* and *few resources* was somewhat higher in Ireland (106 points) than internationally.

The largest gaps in environmental knowledge between students with *many resources* and *some resources* were seen in Sweden and the United States (81 and 67 points respectively), while Japan had the smallest gap (28 points). For the difference between the *many resources* and *few resources* categories, similarly, the largest gap was found in Sweden (144 points) and the smallest in Japan (75 points).

Table 3.2: Percentages and mean achievement of students by Home Educational Resources (HER) scale in Ireland and selected countries, Eighth Grade environmental knowledge

	Overall Mean	Many Resources		Some Resources		Few Resources	
		%	Mean	%	Mean	%	Mean
Singapore	593	33	637	47	590	20	531
Chinese Taipei	553	36	594	43	548	21	494
Japan	549	43	572	46	544	12	497
Korea, Rep. of	547	56	572	34	528	10	477
Finland	534	42	577	46	520	12	458
Sweden	534	42	592	43	511	15	449
England	530	36	581	44	522	20	462
Ireland	**529**	**39**	**570**	**45**	**520**	**16**	**465**
Australia	519	42	565	45	506	13	437
United States	516	31	575	45	508	23	460

Chapter 4:

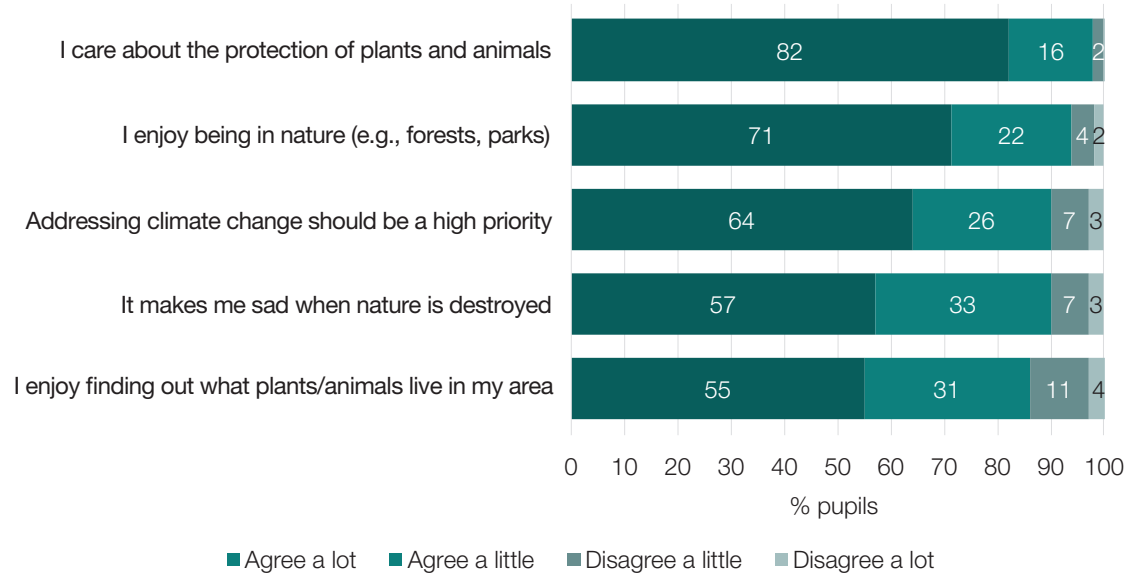
Student attitudes to environmental preservation

This chapter presents data for a new measure administered for the first time in TIMSS 2023: students' attitudes to environmental preservation.[5] This was administered as a series of questions in the Student Questionnaire to both Fourth Grade and Eighth Grade students. Responses from these items were used to create a scale representing students' attitudes to environmental preservation, on the basis of which students were categorised as *very strongly valuing* environmental preservation, *strongly valuing* environmental preservation, or *somewhat valuing* environmental preservation.[6] This chapter presents findings for Ireland from both the item-level data and the scale.

Attitudes to environmental preservation in Fourth Class

Fourth Class pupils were asked how much they agreed or disagreed with several aspects relating to environmental preservation. Their responses are shown in Figure 4.1. As shown, almost all Fourth Class pupils agreed (a lot or a little) that they care about protecting plants and animals and that they enjoy being in nature. The vast majority of pupils – about nine in ten – also agreed that addressing climate change should be a high priority, and that they feel sad when nature is destroyed. The lowest level of agreement related to the extent to which pupils enjoy finding out about the types of plants and animals that live in their area, for which 86% of pupils agreed a lot or a little.

Figure 4.1: Fourth Class pupils' views on aspects of environmental preservation



5 The *TIMSS 2023 Environmental Attitudes and Behavior Framework* (Reynolds & Komakhidze, 2022, p.3) describe environmental preservation as reflecting "an individual's endorsement of conservation and protection of nature" while environmental utilization refers to "an individual's endorsement of human use of natural resources and the environment." The authors note that Fourth grade pupils were presented only with items relating to preservation, while Eighth grade students also saw items relating to utilization. However, as noted below, utilization-themed items generally were not included in the final environmental preservation scale.

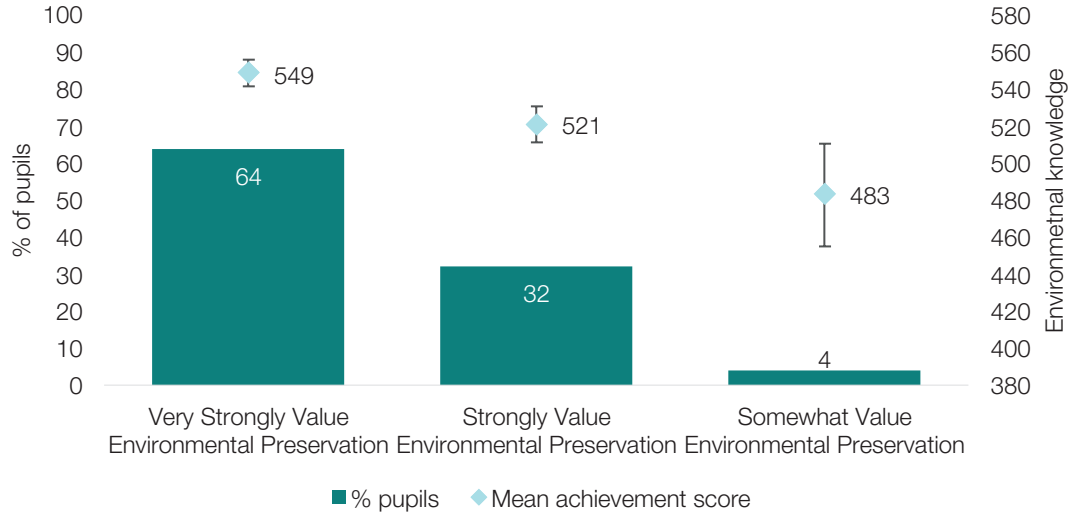
6 For more detail on the construction of the scale and the resulting categories, see von Davier et al. (2024).

As noted above, pupils' responses to these five items were used to compute an overall scale representing their attitudes to environmental preservation. In Ireland, correlation between Fourth Class pupils' attitudes to environmental preservation and their environmental knowledge[7] was small, at *r*=.18. Internationally, the correlations between the two measures were also small, with an average correlation across all TIMSS countries of .14. The size of this relationship varied from negligible in Bosnia and Herzegovina (*r*=-.05) and Chinese Taipei and Poland (both *r*=.03), to small-to-moderate in Italy and Qatar (both *r*=.24) and the United Arab Emirates (*r*=.25). Among the reference countries presented in earlier chapters, the correlations ranged from *r*=.03 (Chinese Taipei) to *r*=.19 (United States).

Nonetheless, significant differences in environmental knowledge can be seen between the Fourth Class pupils who *very strongly value* environmental preservation compared to those who *strongly value* or *somewhat value* environmental preservation (Figure 4.2).

Overall, slightly less than two-thirds of Fourth Class pupils (64%) were categorised as *very strongly valuing* environmental preservation; their mean achievement for environmental knowledge was 549 scale points. About one-third (32%) of pupils *strongly valued* environmental preservation, with a mean score that was 28 points lower (521). A small proportion of pupils (4%) were categorised as only *somewhat valuing* environmental preservation, with a mean score (483) that was substantially below that of both of the other categories. The differences in environmental knowledge between each of these groups were statistically significant (albeit that the proportion of pupils in the *somewhat value* category was very small).

Figure 4.2: Relationship between environmental knowledge and attitudes to environmental preservation, Fourth Class



Internationally, on average, 56% of Fourth Grade pupils were classified as *very strongly valuing environmental preservation*. In addition, 38% of Fourth Grade pupils on average were categorised as *strongly valuing environmental preservation*, with 6% in the *somewhat value* category.

7 See Chapters 2 and 3 for more detailed findings related to students' environmental knowledge.

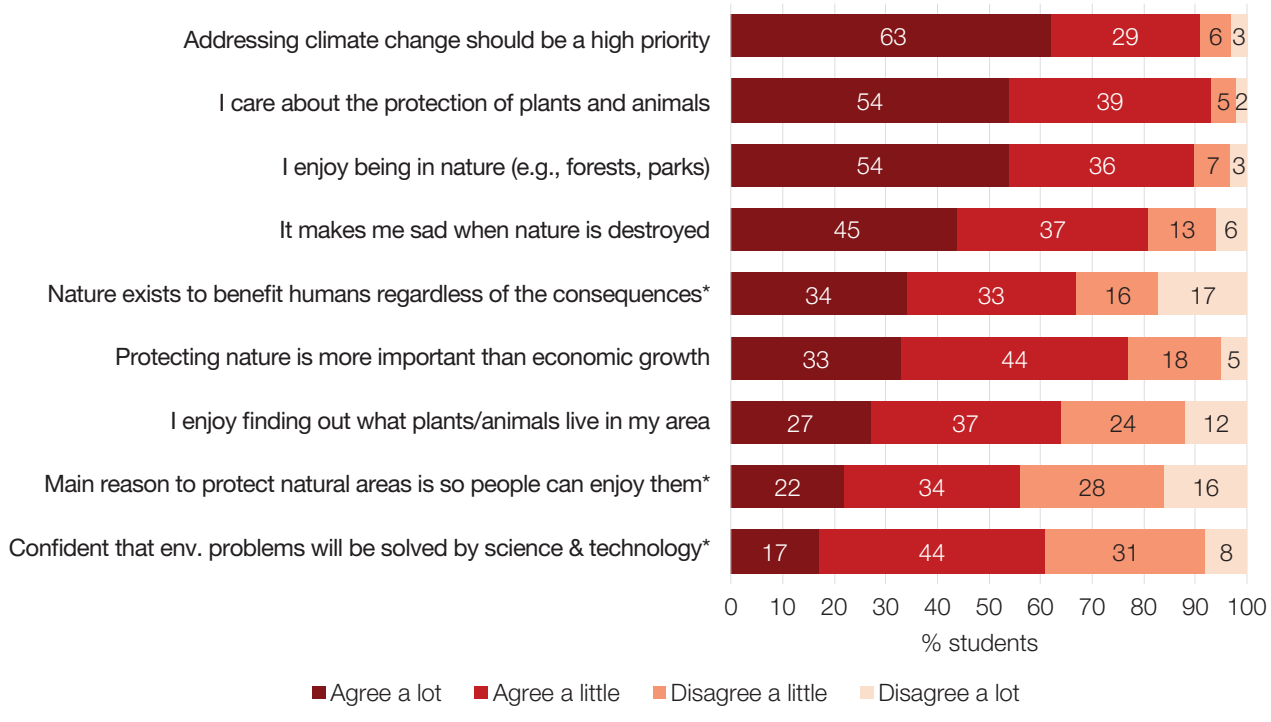
Attitudes to environmental preservation in Second Year

Second Year students were presented with the same set of items as Fourth Class pupils, plus four additional items (Figure 4.3). Six of these items (noted below) were subsequently used at an international level to construct a scale representing Eighth Grade students' attitudes to environmental preservation (von Davier et al., 2024).

As shown in Figure 4.3, Second Year students generally tended to express lower levels of agreement with the various aspects of environmental preservation than was seen among Fourth Class pupils. The strongest levels of agreement were found for three statements relating to climate change as a priority concern, caring about protecting plants and animals; and enjoying being in nature. However, even for these aspects, between 7% and 10% of students disagreed a lot or a little, and levels of agreement were more tempered than at Fourth Class (with relatively more students agreeing 'a little' rather than 'a lot').

Substantial minorities of Second Year students disagreed that the most important reason for protecting natural areas is so people can enjoy them; that they believe environmental problems will be solved by science and technology; that nature exists to benefit humans regardless of the consequences; and that they enjoy finding out about the types of plants and animals in their area.

Figure 4.3: Second Year students' views on aspects of environmental preservation



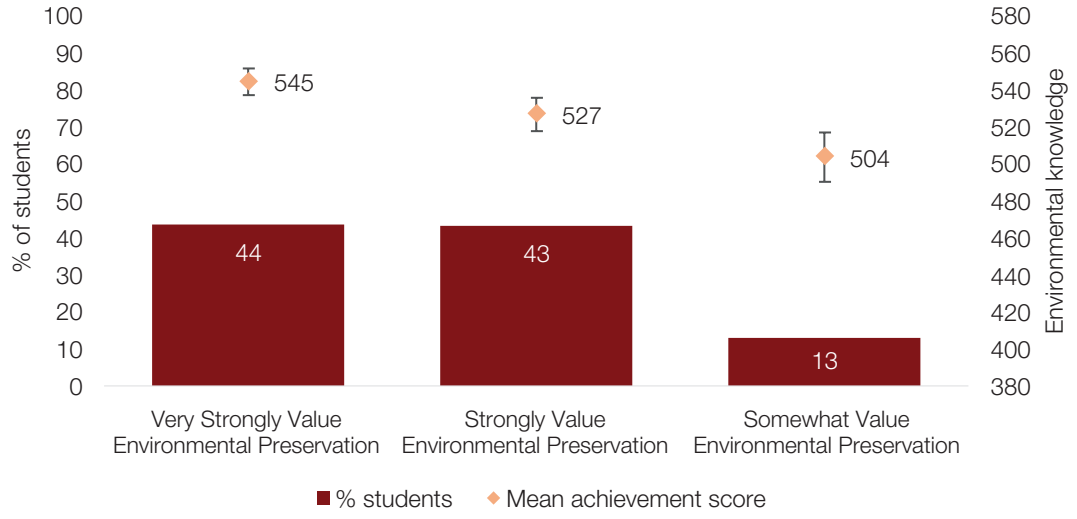
**Item not included in environmental preservation scale.*

As at primary level, the relationship between students' attitudes to environmental preservation and their level of environmental knowledge, as measured by the TIMSS assessment, was low. The magnitude of the relationship in Ireland was small, at *r*=.14. Internationally, the average correlation across TIMSS countries was .08. The size of the correlation for individual countries ranged from -.01 (Brazil, Türkiye, Japan, Portugal, Chinese Taipei) and .00 (Georgia) up to .20 (Palestinian National Authority) and .32 (Malaysia). Among our set of reference countries, correlations ranged from -.01 (Japan and Chinese Taipei) to *r*=.15 (England).

Among Second Year students, approximately equal percentages were categorised as *very strongly valuing* (44%) and *strongly valuing* (43%) environmental preservation (Figure 4.4). About one in eight Second Year students (13%) *somewhat value* environmental preservation. On average across TIMSS countries, the corresponding percentages were 48%, 41%, and 12%, respectively. This indicates that a slightly smaller percentage of students in Ireland expressed the highest levels of support for environmental preservation compared to their peers in other countries.

The mean scores for environmental knowledge achieved by Second Year students in each of these categories were 545, 527, and 504, respectively. The differences in achievement between each of the three groups were statistically significant. That is, students who *very strongly value* environmental preservation achieved a significantly higher score for environmental knowledge than students in either of the other two categories, while those who *strongly value* environmental preservation achieved a higher score than those in the *somewhat value* group.

Figure 4.4: Relationship between environmental knowledge and attitudes to environmental preservation, Second Year



Chapter 5:

Environmental awareness in the home

This chapter describes reports from students and parents/guardians about the frequency with which they engage in various activities related to helping the environment.

Parents/guardians

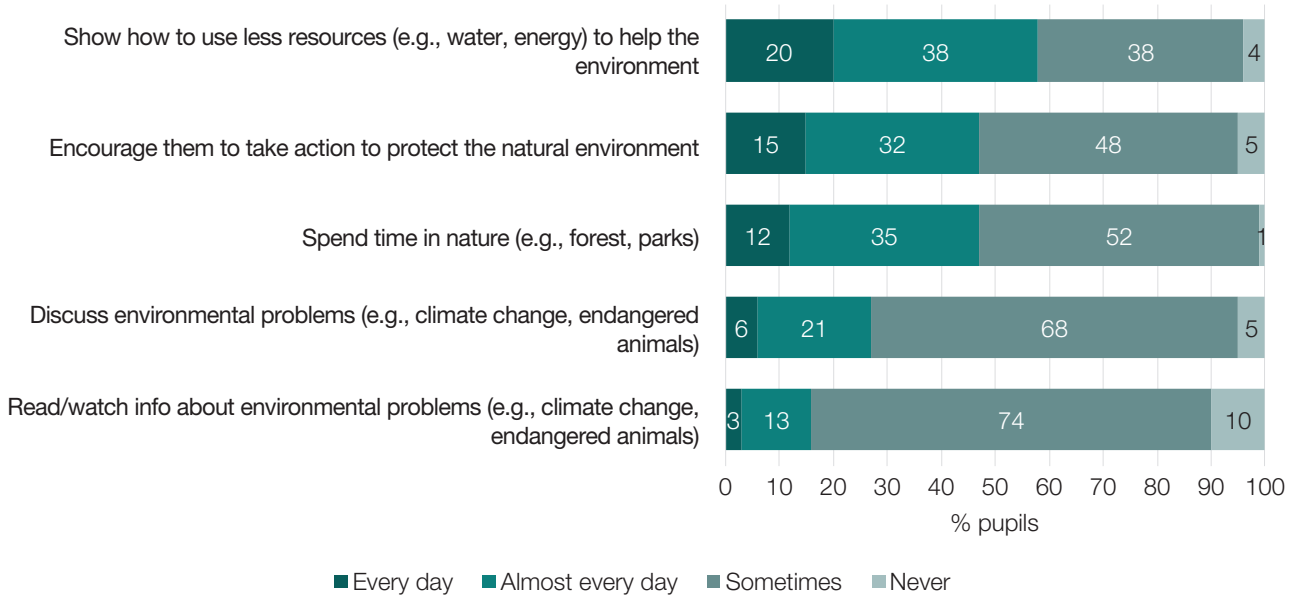
The parents or guardians of Fourth Class pupils were asked how often they (or another person in their home) do various activities with their child; their responses are shown in Figure 5.1.

Showing children how to use fewer resources to help the environment was reported as the most common activity, with one-fifth of pupils (20%) doing this every day with their parents and almost two-fifths (38%) doing so almost every day. Just under half of pupils (47%) were encouraged (almost) daily to take action to protect the environment, and a similar proportion spent time in nature (almost) daily with a member of the household. About half of pupils (48% and 52%, respectively) sometimes engaged in both of the latter activities.

Few pupils discuss environmental problems or read/watch information about environmental problems with someone at home daily. However, a minority do so almost every day (21% and 13%, respectively) and between two-thirds and three-quarters of pupils sometimes discuss or learn about environmental problems.

Very few pupils are reported as never spending any time in nature (1%), while small percentages never engage in most of the other activities with a family member. The highest level of disengagement in this regard was for reading/watching information about environmental problems, which 10% of pupils never engage in at home.

Figure 5.1: Parent/guardians' frequency of engagement in environmental awareness activities with their child



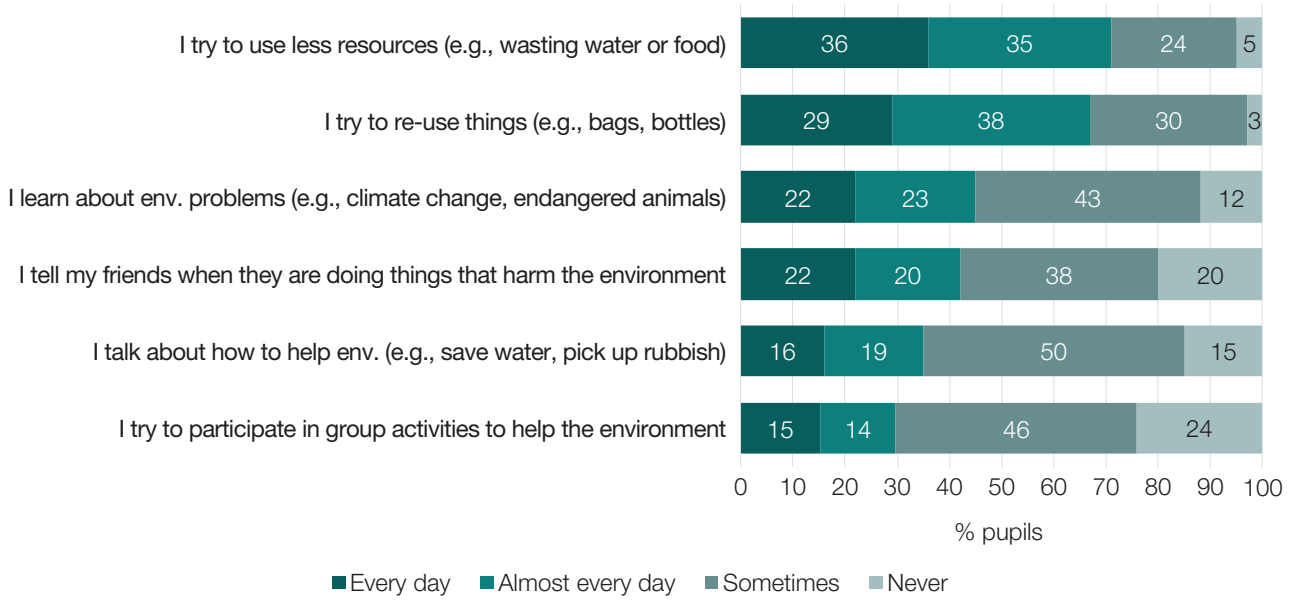
Fourth Class pupils

Fourth Class pupils were also asked about the frequency with which they take various actions "to help the natural environment" – that is, with a particular focus on an environmental perspective and motivations relating to helping the environment (Figure 5.2).

In line with the parental reports described above, the most common activity reported by Fourth Class pupils was making an effort to use fewer resources (71% doing so daily or almost daily) and, relatedly, making an effort to re-use objects such as bags or bottles (66% daily or almost daily). Few pupils claimed that they never made an effort to conserve resources in these ways.

For each of the remaining activities, the frequency most commonly reported by pupils was 'sometimes'. These included learning about environmental problems (43% sometimes), telling friends when they are doing harm to the environment (38%), talking about how to help the environment (50%), and participation in group activities to help the environment (46%). About one-quarter of pupils (24%) said that they never participate in group activities to help the environment.

Figure 5.2: Fourth Class pupils' frequency of engagement in activities to help the natural environment



Second Year students

As with the Fourth Class pupils, students in Second Year were asked to report how often they take actions "to help the natural environment" (Figure 5.3).

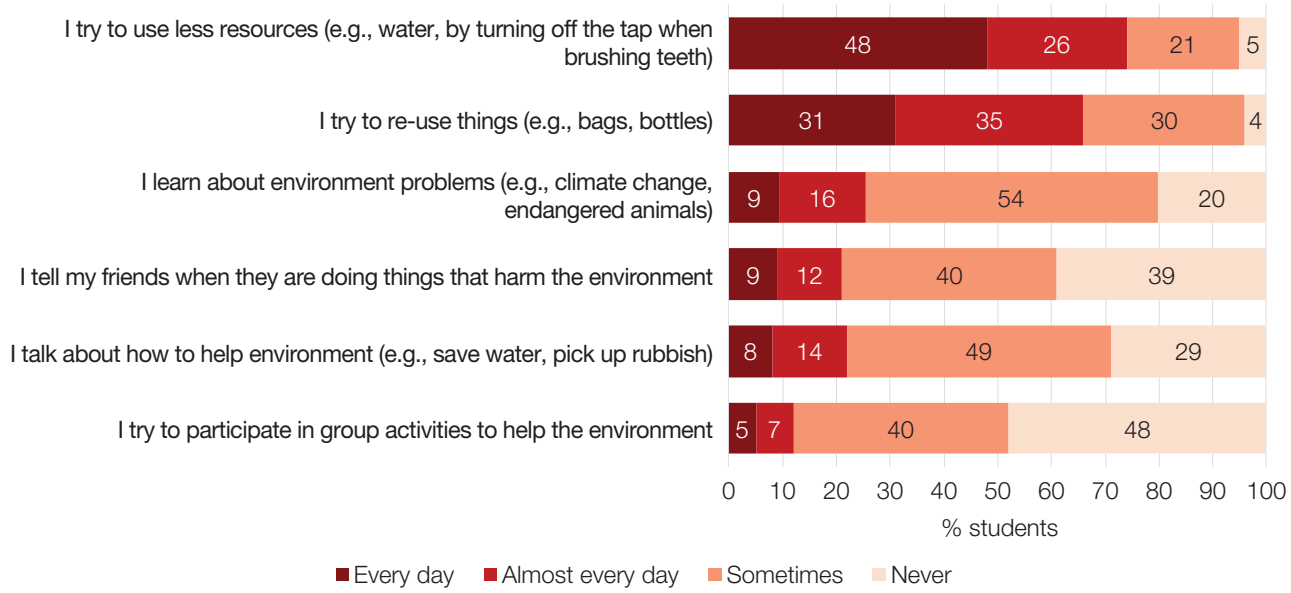
Similarly to the younger cohort, Second Year students reported most often trying to conserve resources either by using fewer resources (74% daily or almost daily) or by re-using existing objects (65%). Most of the students who engaged in these activities less frequently did so sometimes, with small percentages reporting that they never attempt to conserve resources.

Frequent engagement in each of the other activities was noticeably less common among Second Year students than among the Fourth Class pupils. However, the rank ordering – that is, the frequency of each activity relative to the others – was identical for both groups of students.

Between 21% and 25% of Second Year students reported that they try to learn about environmental problems, talk about how to help the environment, or tell friends when they are harming the environment on a daily or almost daily basis. Although two-fifths of students (39%) said that they never tell their friends when they are doing something to harm the environment, a majority of students reported that they do so at least sometimes.

Finally, about one-in-eight students (12%) reported that they try to participate in group activities to help the environment (almost) daily, while two-fifths (40%) of their peers do so sometimes and almost half (48%) never do so.

Figure 5.3: Second Year students' frequency of engagement in activities to help the natural environment



Chapter 6:

Environmental awareness at school

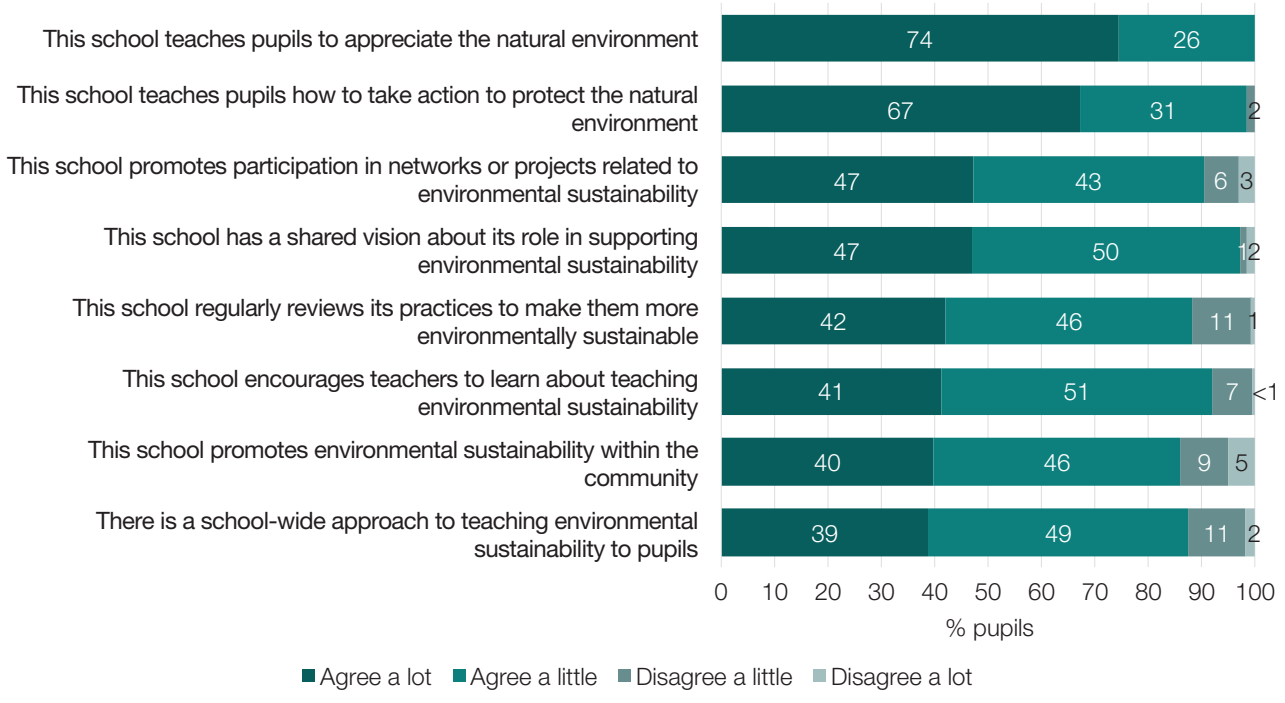
This chapter presents insights from teachers and school principals regarding the school's focus on environmental sustainability. It covers the frequency of sustainability-related teaching practices, activities conducted with students on environmental issues and sustainability, teachers' attitudes towards prioritising environmental sustainability, and engagement in professional development opportunities related to sustainability.

School emphasis on environmental sustainability in Fourth Class

Figure 6.1 presents percentages of Fourth Class pupils based on their school's emphasis on various activities related to environmental sustainability, as reported by school principals. The data reveal a strong commitment among schools to environmental sustainability.

All or nearly all pupils attended schools where they were taught to appreciate and protect the natural environment, and where a shared vision for their role in supporting sustainability was in place. Slightly less than 90% of pupils attended schools where the principal agreed that they conducted regular reviews of practices related to sustainability or had a school-wide approach to teaching sustainability. Support for teachers was also evident, with only 7% of pupils in schools where principals disagreed that teachers were encouraged to learn about teaching sustainability. Finally, notable proportions of pupils (about nine-in-ten) attended schools that promoted participation in sustainability networks or projects, or promoted environmental sustainability within the community.

Figure 6.1: Schools' emphasis on activities related to environmental sustainability, Fourth Class



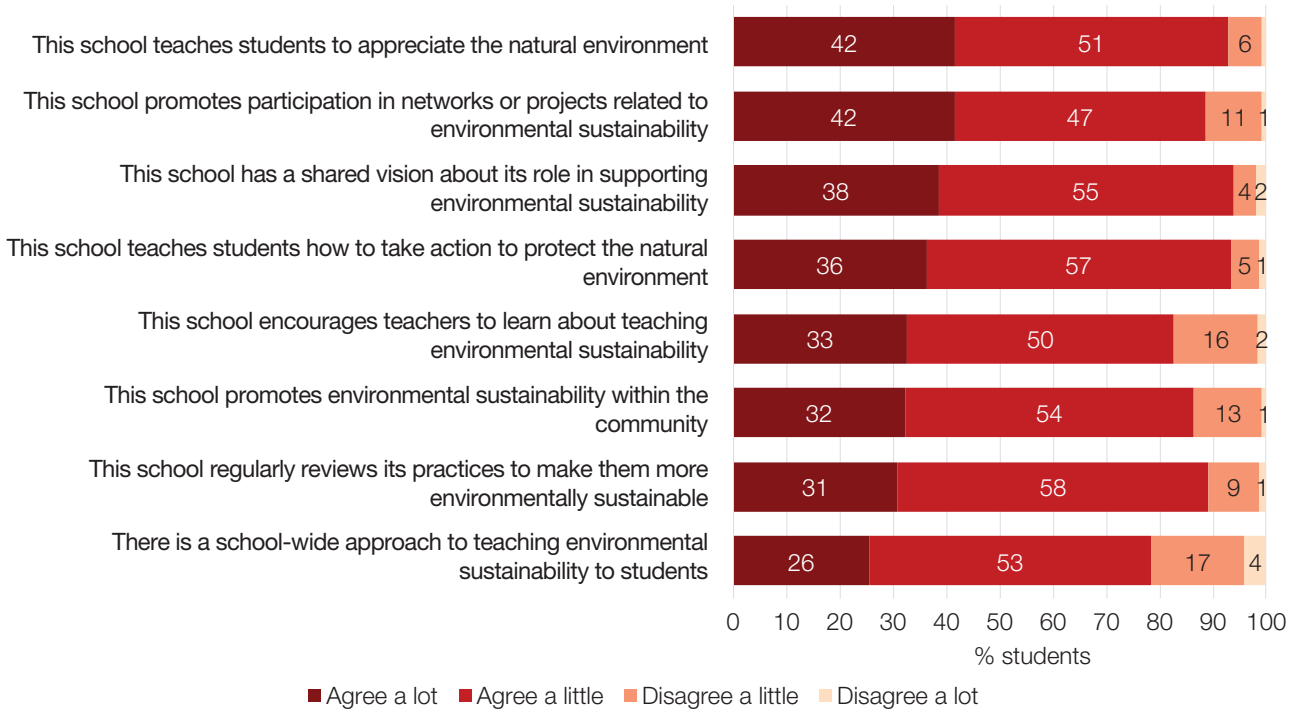
School emphasis on environmental sustainability in Second Year

Figure 6.2 presents percentages of Second Year students based on their school's emphasis on various activities related to environmental sustainability, as reported by school principals.

Over 90% of students attended schools where they were taught to appreciate and protect the natural environment, and where a shared vision for the school's role in supporting sustainability was reported. More than 85% of students attended schools that conducted regular reviews of practices related to sustainability, promoted environmental sustainability within the community, and encouraged participation in sustainability networks or projects.

However, about one-fifth of students attended schools where principals reported a lack of a school-wide approach to teaching sustainability (17% disagreeing a lot and 4% disagreeing a little) or a lack of encouragement for teachers to learn about teaching sustainability (16% disagreeing a lot and 2% disagreeing a little).

Figure 6.2: Schools' emphasis on activities related to environmental sustainability, Second Year



Fourth Class classrooms

Teaching practices

Figure 6.3 presents percentages of Fourth Class pupils based on the frequency with which various teaching practices on environmental sustainability were employed in their classrooms, as reported by their teachers.

A majority of pupils (56%) were taught to develop positive attitudes towards the natural environment at least once a week, with an additional 36% being so taught once or twice a month. Around two-thirds of pupils were encouraged by their teachers to reduce resource use, such as water and energy, on a weekly basis. Regular discussions on how pupils' actions can help the environment occurred at least once a week for 49% of students, while 44% were reported to engage in weekly discussions on broader environmental issues such as climate change and endangered animals.

While the majority of pupils were engaged at least on a monthly basis in these sustainability practices, one-fifth were taught by teachers who engaged their pupils in discussions on broader environmental issues such as climate change or endangered animals no more than a few times a year.

Figure 6.3: Teachers' frequency of teaching practices on environmental sustainability, Fourth Class

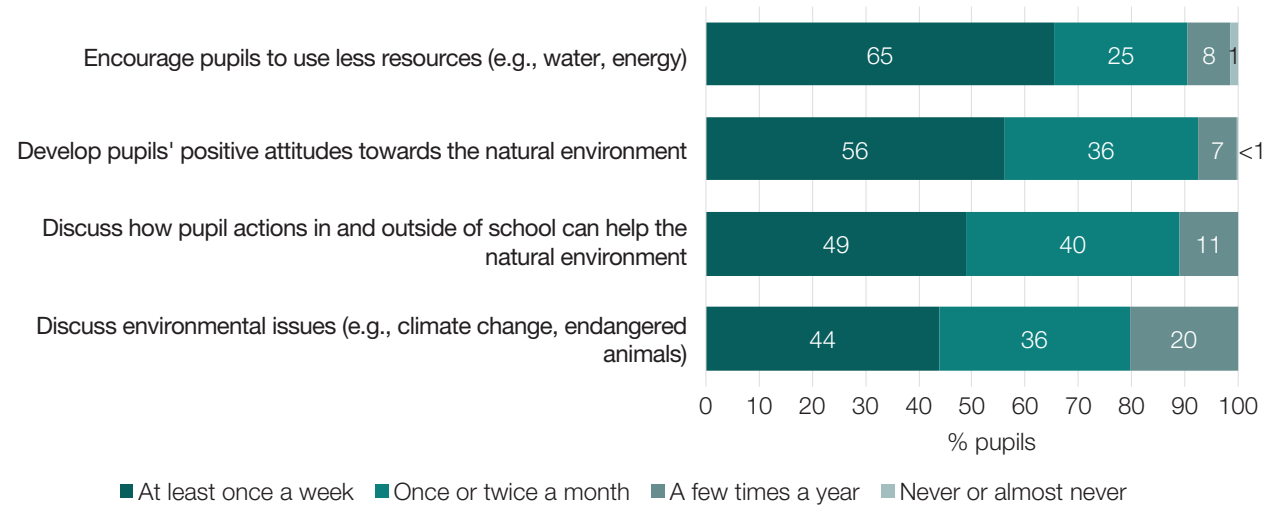
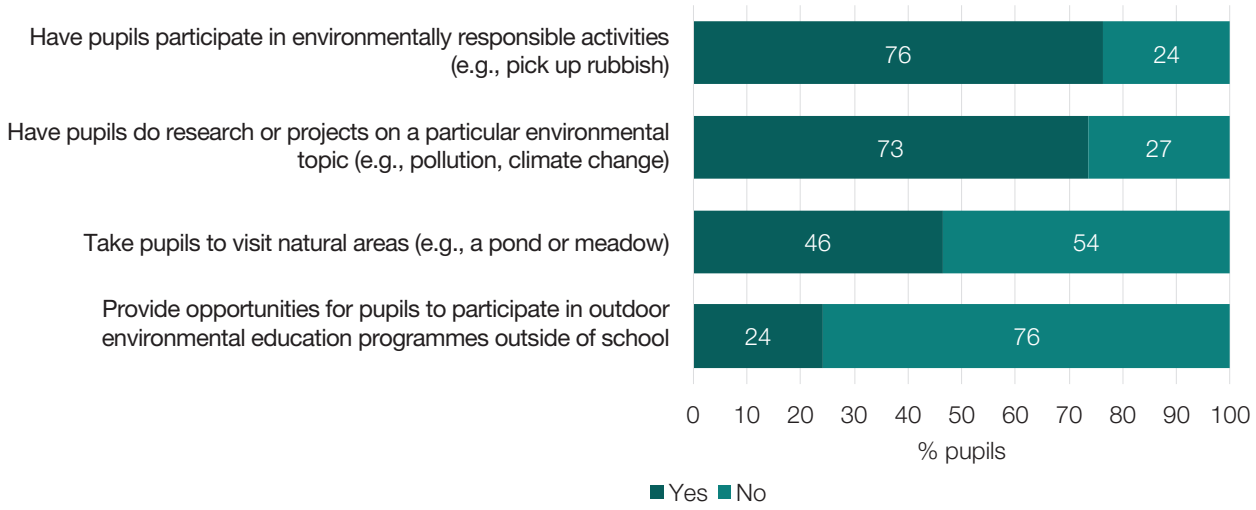


Figure 6.4 presents the percentages of Fourth Class pupils based on their engagement in activities on environmental issues and sustainability in class, as reported by their teachers. Approximately three-quarters of pupils were taught by teachers who had them participate in environmentally responsible activities such as picking up rubbish, or had them do research or projects on a specific environmental topic. Just under half of pupils were taught by teachers who took them to visit natural areas such as ponds or meadows (46%), and one-quarter had teachers who provided opportunities for pupils to participate in outdoor environmental education programmes outside of school (24%).

Figure 6.4: Teachers' engagement in activities on environmental issues and sustainability, Fourth Class



Teachers' attitudes

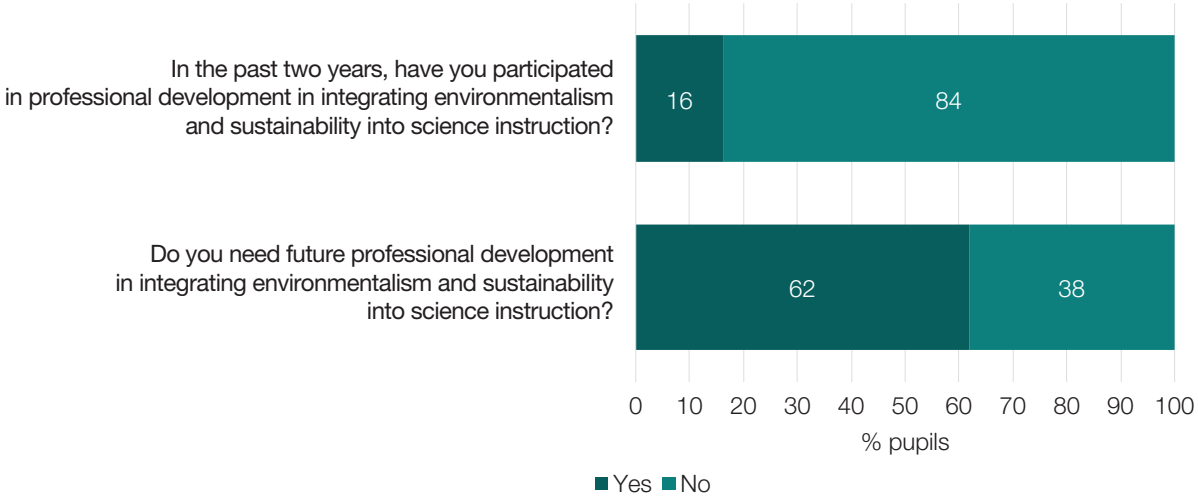
Fourth Class teachers were asked about whether they believed education on environmental sustainability should be a priority for schools, with all pupils being taught by teachers who either agreed a lot (80%) or a little (20%) that it should be a priority.

Professional development

As part of the Teacher Questionnaire, teachers were asked to indicate whether they had completed professional development in integrating environmentalism and sustainability into science instruction in the two years preceding TIMSS 2023, and whether they needed future professional development in this area (Figure 6.5).

A relatively small proportion of pupils (16%) were taught by teachers who had participated in professional development related to integrating environmentalism and sustainability into science instruction in the previous two years. Conversely, approximately two-thirds of pupils were taught by teachers who reported needing future professional development in this area.

Figure 6.5: Teachers' professional development in integrating environmentalism and sustainability into science instruction, Fourth Class



Second Year classrooms

Teaching practices

Figure 6.6 presents percentages of Second Year students based on the frequency with which various teaching practices on environmental sustainability were employed in their classrooms, as reported by their science teachers.

Almost half of the students (47%) were taught to develop positive attitudes towards the natural environment at least once a week, with an additional 41% being taught positive environmental attitudes once or twice a month. Just under one-third of students were encouraged by their teachers to reduce resource use, such as water and energy, on a weekly basis, while 2% of students never or almost never received such encouragement. Regular discussions on how students' actions can help the environment occurred at least once a week for 26% of students, while 22% were reported to be engaged in weekly discussions on broader environmental issues such as climate change and endangered animals.

Overall, most students were engaged at least on a monthly basis in these sustainability practices. However, around one-quarter were taught by teachers who encouraged them to use less resources and engaged them in discussions related to the environment no more than a few times a year.

Figure 6.6: Teachers' frequency of teaching practices on environmental sustainability, Second Year

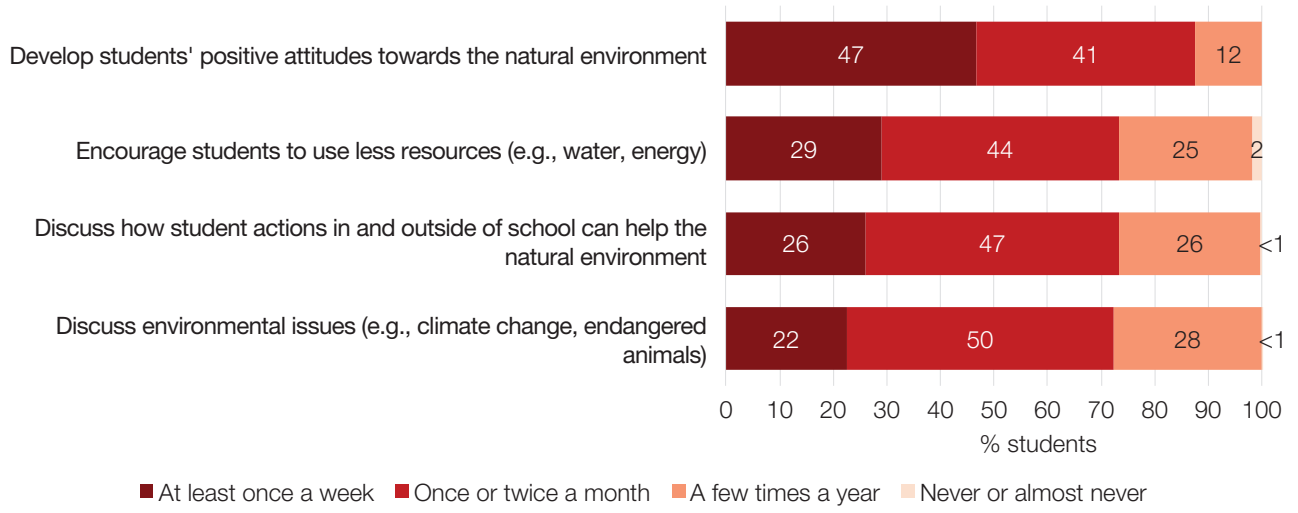
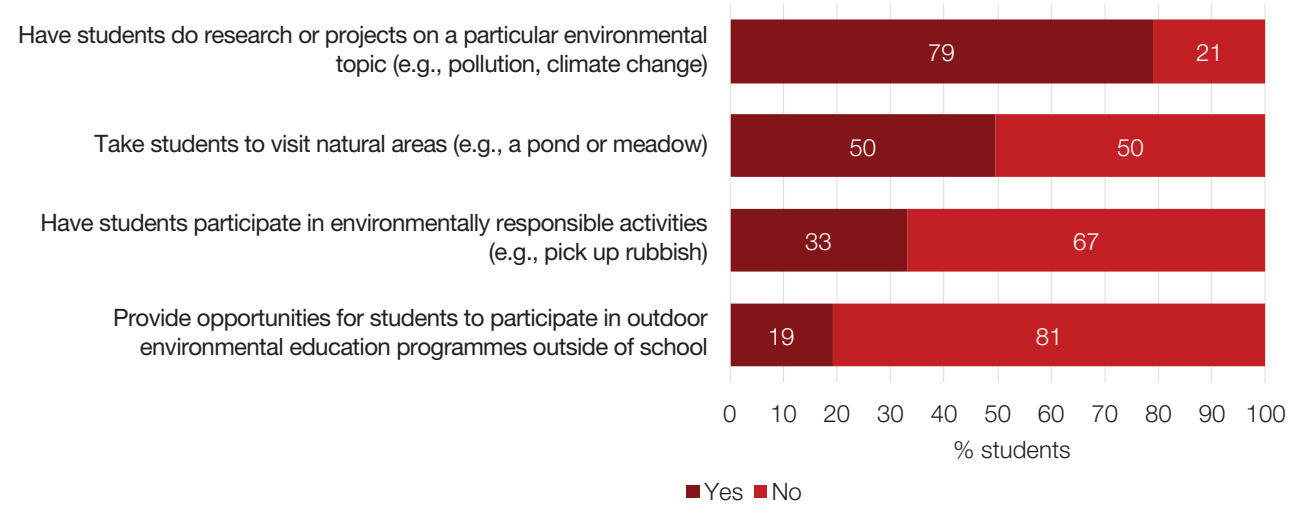


Figure 6.7 presents the percentages of Second Year students based on their engagement in activities on environmental issues and sustainability in class, as reported by their science teachers. Approximately four-fifths of students (79%) were taught by teachers who had them do research or projects on a particular environmental topic. Half of Second Year students had teachers who took them to visit natural areas such as ponds or meadows, while one-third had teachers who had students participate in environmentally responsible activities. Approximately one-fifth of students (19%) were taught by teachers who provided opportunities for them to participate in outdoor environmental education programmes outside of school.

Figure 6.7: Teachers' engagement in activities on environmental issues and sustainability, Second Year



Teachers' attitudes

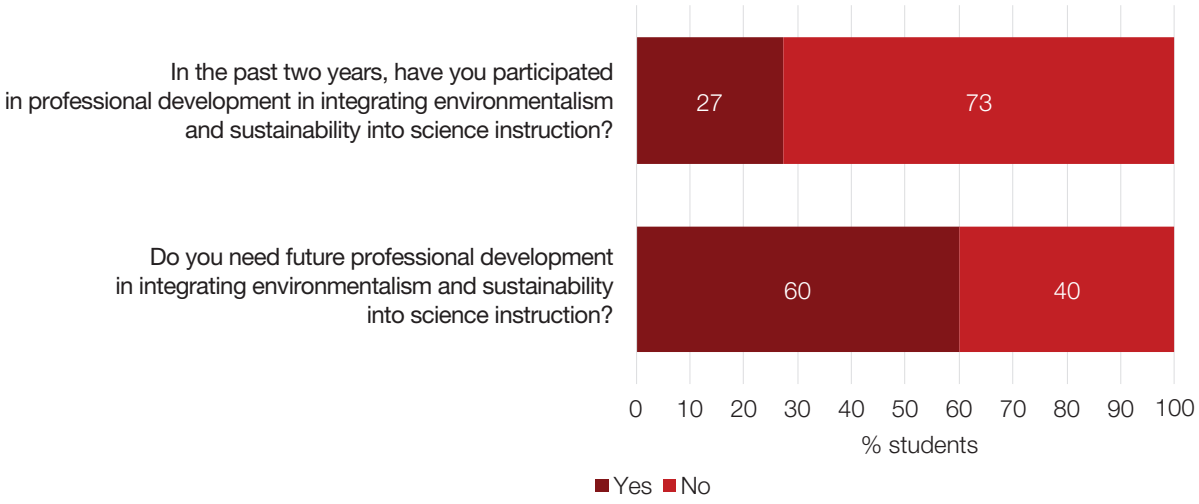
The science teachers of Second Year students were asked about whether they believed education on environmental sustainability should be a priority for schools. Most students were taught by teachers who either agreed a lot (72%) or a little (26%) that it should a priority, with 2% of students being taught by teachers who disagreed a little.

Professional development

Science teachers were also asked to indicate whether they had completed professional development related to integrating environmentalism and sustainability into science instruction in the two years preceding TIMSS 2023, and whether they needed future professional development in this area (Figure 6.8).

Just over one-quarter of students were taught by teachers who had participated in professional development fitting this description in the two years prior to TIMSS 2023. A majority of students (60%) had science teachers who reported a need for future professional development in this area.

Figure 6.8: Teachers' professional development in integrating environmentalism and sustainability into science instruction, Second Year



Chapter 7:
Summary and discussion

Following the completion of TIMSS 2019, a subset of items measuring environmental awareness were identified post hoc from the science assessment, which enabled the construction of scales to provide a measure of **environmental knowledge** for Fourth and Eighth Grade students. This concept was further developed for the 2023 cycle of TIMSS assessment, which also introduced new items to the Student, Home, School and Teacher Questionnaires. These items aimed to enhance understanding of Fourth and Eighth Grade students' attitudes to the environment, their endorsement of environmentally responsible behaviours, and the contribution of the home, schools and classrooms to students' **environmental attitudes**. In TIMSS, **environmental awareness** is defined as encompassing both environmental knowledge and environmental attitudes:

Environmental awareness	**=**	**Environmental knowledge**	**+**	**Environmental attitudes**

This chapter summarises the main findings about students' environmental awareness in TIMSS 2023, as described in the previous chapters. The chapter concludes with a discussion of the findings and highlights some areas of focus for policymakers.

Summary of key findings

This section presents a summary of the environmental knowledge of Fourth Class and Second Year students and the environmental attitudes of students, parents/guardians, school principals, and teachers.

Environmental knowledge

Fourth Class

Fourth Class pupils achieved a mean score for environmental knowledge of 536, which was significantly above the TIMSS 2023 international average (496). Seven countries (including one EU country: Poland) achieved mean scores significantly higher than Ireland's, while 10 countries (including five EU countries: Finland, Denmark, Hungary, Bulgaria and Sweden) had similar scores. The remaining 39 countries had significantly lower mean scores on environmental knowledge than Ireland.

Pupils in Ireland scored significantly higher on environmental knowledge than on overall science, by four points. Overall, 13 countries (including Ireland) scored significantly higher on environmental knowledge than on overall science, while 19 countries scored significantly lower on environmental knowledge than on overall science.

Boys and girls in Ireland achieved similar mean scores on environmental knowledge. Among the selected reference countries, boys significantly outperformed girls on environmental knowledge in seven of the 10 countries (including Singapore, Chinese Taipei, Sweden, and Australia) while Finland and England, as well as Ireland, had no significant gender differences.

The differences by school DEIS status on environmental knowledge are similar to those reported for mathematics and science overall (McHugh, Denner et al., 2024). Pupils in DEIS Urban Band 1 and Urban Band

2 schools scored significantly lower on environmental knowledge than pupils in non-DEIS schools, while pupils in DEIS Rural schools performed similarly to those in non-DEIS schools.

Examined by individual-level socioeconomic status, pupils in Ireland in the *higher SES* category achieved a significantly higher mean score on environmental knowledge than those in the *middle SES* or *lower SES* categories. This pattern was observed across all the selected reference countries and also mirrors the pattern observed in Ireland for mathematics and science (McHugh, Denner et al., 2024).

Second Year

Second Year students achieved a mean score on environmental knowledge of 529, which was significantly above the TIMSS 2023 international average (475). Four countries – all outside of the EU – achieved mean scores significantly higher than Ireland's. Six countries (including two EU countries: Finland and Sweden) achieved similar scores to Ireland. The remaining 32 countries had significantly lower mean scores on environmental knowledge than Ireland.

Second Year students scored significantly higher on environmental knowledge than on science overall, by four score points. Internationally, 10 countries (including Ireland) had significantly higher mean scores on environmental knowledge than on overall science, while 16 had significantly lower scores on environmental knowledge than on science.

In Ireland, boys significantly outperformed girls on environmental knowledge, consistent with the pattern seen for overall science in TIMSS 2023 (McHugh, Denner et al., 2024). This pattern was observed in five of the selected reference countries, including England, Australia and the United States. In the other four countries (Finland, Chinese Taipei, Sweden and Singapore), there were no significant differences on environmental knowledge by gender.

Second Year students in DEIS schools had significantly lower achievement on environmental knowledge than students in non-DEIS schools. Looking at the differences by the individual student socioeconomic status measure, students with *many resources* at home achieved a significantly higher mean score than students with *some resources* or *few resources*. A similar pattern was also observed for mathematics and overall science achievement among Second Year students (McHugh, Denner et al., 2024).

Environmental attitudes

Students

The Student Questionnaire included items relating to students' attitudes towards environmental preservation. Almost two-thirds of Fourth Class pupils were categorised as *very strongly valuing environmental preservation,* with almost all pupils agreeing (a lot or a little) that they care about the protection of plants and animals and enjoy being in nature.

At Second Year, a lower proportion of students – over two-fifths – were categorised as *very strongly valuing environmental preservation*. More than 90% of Second Year students agreed (a lot or a little) that addressing climate change should be a high priority and that they care about the protection of plants and animals. Approximately two-thirds of students agreed that nature exists to benefit humans regardless of consequences, and that they enjoy finding out what plants or animals live in their area.

Students were also asked about environmentally responsible behaviours and how often they engaged in these behaviours. The majority of Fourth Class pupils reported trying to use fewer resources or to re-use things on a daily or almost daily basis. Other activities were engaged with less frequently. For example, approximately one-fifth of pupils reported never telling their friends when they are doing things that harm the environment or trying to participate in group activities to help the environment. Similarly to Fourth Class, most Second Year students (two-thirds or more) reported trying to conserve resources by using less or by re-using things such as bags or bottles on a daily or almost daily basis. Almost half of Second Year students never participated in group activities to help the environment, while one-in-eight students participated in such activities on a daily or almost daily basis.

Parents/guardians

In the Home Questionnaire, parents/guardians of Fourth Class pupils were asked how often they engaged in various activities relating to the environment with their child. The activity reported most frequently was showing their child how to use fewer resources to help the environment, with parents/guardians of one-fifth of pupils doing so on a daily basis and an additional two-fifths on an almost daily basis. Parents/guardians of almost half of pupils reported encouraging their child (almost) daily to take action to protect the natural environment or to spend time in nature. Discussing environmental problems and reading or watching information about environmental problems were less common activities, with parents/guardians of small proportions (one-tenth or less) of pupils never doing so.

Schools

The School Questionnaire asked principals about their schools' emphasis on environmental sustainability. The findings show a strong commitment to environmental sustainability among both primary and post-primary schools.

At both Fourth Class and Second Year, all or almost all students attended schools where principals reported that appreciation and protection of the natural environment was taught, and where a shared vision for their role in supporting sustainability was in place. More than 90% of pupils in Fourth Class attended schools where principals reported encouraging teachers to learn about teaching environmental sustainability and promoting participation in networks or projects relating to environmental sustainability. However, at Second Year, more than one-fifth of students attended schools where principals reported a lack of a school-wide approach to teaching environmental sustainability to students.

Teachers

The Teacher Questionnaire asked all teachers at primary level, and science teachers in post-primary schools, about their teaching practices relating to environmental sustainability, activities conducted with students on environmental issues and sustainability, the extent to which they agreed that education about environmental sustainability should be a priority for schools, and professional development relating to integrating environmentalism and sustainability into science instruction.

More than half of Fourth Class pupils were taught by teachers who reported that they develop pupils' positive attitudes towards the natural environment and encourage pupils to use less resources on at least a weekly basis. Less than half of Fourth Class pupils were taught by teachers who discussed how pupils' actions in and outside school can help the natural environment, or discussed environmental issues on at least a weekly basis.

Second Year science teachers reported using these teaching practices less frequently than Fourth Class teachers. While almost half of Second Year students were taught by teachers who aimed to develop students'

positive attitudes towards the natural environment on at least a weekly basis, several other activities (such as encouraging students to use fewer resources; discussing how their actions in and outside of schools can help the natural environment; and discussing environmental issues) were reported less frequently.

Approximately three-quarters of students in both Fourth Class and Second Year were taught by teachers who had them complete research or projects on environmental topics such as pollution or climate change. Similarly high proportions at primary level – about three-quarters of Fourth Class pupils – participated in environmentally responsible activities such as picking up rubbish at school. However, the corresponding figure at Second Year (about one-third of students) was substantially lower. Almost half of students at both grade levels were taught by teachers who took them to visit a natural area such as a meadow or a pond. Finally, about one-quarter of Fourth Class pupils and one-fifth of Second Year students were given opportunities by their teachers to participate in outdoor environmental education programmes outside school.

All Fourth Class pupils and almost all Second Year students (98%) were taught by teachers who agreed that education on environmental sustainability should be a priority for schools. However, the teachers of a minority of students at both grade levels had participated in any professional development relating to integrating environmentalism and sustainability into science instruction in the two years prior to the survey. Most students – about three-fifths at each grade level – had a teacher who said that they would need future professional development on this topic.

Discussion

TIMSS facilitated the collection of data on environmental awareness (environmental knowledge and attitudes) in response to an increasing awareness and focus on the environment globally. The achievement measure of environmental knowledge, which was introduced in 2019, has been strengthened in 2023 and has been further supported by the introduction of new questionnaire items. Next, we discuss some of the findings in this report in the Irish context to suggest some areas of focus or to highlight developments in this area.

Environmental knowledge as a relative strength for students in Ireland

At both Fourth Class and Second Year, students in Ireland performed significantly higher on environmental knowledge than on science overall. This indicates that environmental knowledge is an area of relative strength for students in Ireland.

Environmental knowledge is measured using a subset of items in the science assessment that relate to the content areas of both Earth Science and Life Science (Fourth Class)/Biology (Second Year). Previous reporting on TIMSS 2023 (McHugh, Denner et al., 2024) showed that Fourth Class pupils had neither a strength nor weakness in Earth Science or Life Science and, among Second Year students, Earth Science was an area of relative strength (with Biology neither a strength nor a weakness). The fact that these broader content domains tended on the whole to be in line with overall science performance highlights the relative strength that students in Ireland have demonstrated here in the more specific domain of environmental knowledge.

This suggests that a strong base exists from which further progress in students' environmental awareness can be encouraged and developed. Future study of particular strengths and weaknesses in students' environmental knowledge – at the more granular level of specific topics or test items – would be possible by following a model similar to that demonstrated by McHugh, Clerkin et al. (2024) with data from TIMSS 2019. For example, in that study, McHugh, Clerkin et al. (2024) found that Fourth Class pupils performed particularly strongly on several environment-related topics, including *the impact of humans on the environment*. Further development of environmental knowledge and awareness among students in Ireland could also consider the

extent to which Vare and Scott's (2007) two types of education for sustainable development – ESD 1 (scientific) and ESD 2 (social/political) – are represented in the national context.

Differences in environmental attitudes between primary and post-primary schools

Overall, high proportions of students reported valuing environmental preservation and regularly engaging with environmentally responsible behaviours. However, it was notable that stronger pro-environment attitudes or greater levels of engagement in relevant activities were reported by Fourth Class pupils than Second Year students.

In addition, although boys and girls in Fourth Class demonstrated very similar levels of environmental knowledge, boys showed stronger environmental knowledge than girls at Second Year. This gender difference at post-primary level only is consistent with the patterns seen for science achievement more generally in TIMSS 2023 (McHugh, Denner et al., 2024). However, the magnitude of the difference between boys and girls is greater for environmental knowledge (18 score points) compared to science (nine points), suggesting that particular attention should be paid to developing girls' environmental knowledge and engaging girls in environmentally relevant learning as they progress through post-primary education.

Responses from the School, Teacher and Home Questionnaires also demonstrated a high level of emphasis on environmental awareness and sustainability at school, in classrooms, and at home. Again, however, engagement with environmental topics or activities tended to be less common in Second Year science classrooms than at Fourth Class. These findings suggest that particular efforts to encourage learning and engagement in areas related to protection of the environment and sustainability may be warranted in post-primary schools. To this end, short courses at junior cycle such as the Climate Action short course which has been developed by Educators for Sustainability (2021) should be considered for wider take-up and further development.

Teacher professional learning for environmentalism and sustainability

Teachers at both primary and post-primary levels identified education on environmental sustainability as a priority for schools, but simultaneously reported a widespread need for professional development in the area of integrating environmentalism and sustainability into science instruction.

At primary level, redevelopments of the curriculum include new specifications for both Science, Technology and Engineering (NCCA, 2024b) and Social and Environmental Education (NCCA, 2024c) which are expected to be published in final form in September 2025. The draft specifications in both cases highlight sustainability and the development of children's awareness of environmental issues. In particular, the Social and Environmental Education specification includes Environment and Sustainable Living as one of three core strands and aims, *inter alia*, to develop pupils' problem-solving skills in order to "empower children to promote a more environmentally, socially, and economically sustainable present and future" (NCCA, 2024c, p.9). It can be expected that, as these aspects of the primary curriculum are rolled out, they will be accompanied by relevant teacher professional learning opportunities that include a clear focus on sustainability and the environment which would go some way to addressing the needs identified by teacher respondents in TIMSS 2023.

Similarly, at post-primary level, professional development providers should consider focusing on the sustainability element of Junior Cycle science in future workshops. In addition, from September 2025, a new Leaving Certificate subject called Climate Action and Sustainable Development is being introduced on a phased basis to Fifth Year students. The overall aim is "to develop students' capacity for informed and meaningful action for a just and sustainable world as they engage with key sustainability challenges, including the climate

crisis" (NCCA, 2024a, p. 5). The introduction of this subject highlights a recognition of the importance of this topic. This, along with professional development opportunities for teachers engaging with this subject, is likely to impact the wider school community. Although TIMSS assesses environmental knowledge mainly from a scientific perspective, the fact that many subject specifications at post-primary level in Ireland include references to the environment and sustainability suggest that the rollout of relevant professional development opportunities should be extended to as many teachers as possible, which may begin to address the need highlighted by teachers for professional development in this area.

TIMSS 2027

The next cycle of TIMSS, in 2027, will continue to enhance the environmental knowledge achievement scale and will include relevant questionnaire items for students, teachers, school principals, and parents/guardians. Therefore, the findings in this report can be taken as a baseline against which data from subsequent cycles can be analysed to monitor trends in student achievement on environmental knowledge, as well as changes in the attitudes and practices of students, teachers, school principals, and parents/guardians over time.

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