

Chapter 4

Attaining Knowledge on Environmental Sustainability: Knowledge and Understanding of Environmental Sustainability Revealed by TIMSS 2023 Data in European Education Systems



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4.1 Introduction

Sustainable development has become a critical priority for contemporary societies. The United Nations' 2030 Agenda established goals towards sustainable development that address social, economic, and environmental challenges, including ending hunger and poverty, protecting natural resources, promoting sustainable production and consumption, and reducing inequality (United Nations, 2015). One highly effective approach to achieving these goals is sustainable education (Krayneva et al., 2021), as emphasized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in *Education for sustainable development: A roadmap* (UNESCO, 2020). Within this framework, environmental sustainability is a key domain and is the central focus of this chapter and volume.

The topic of environmental sustainability is most commonly integrated into the science curriculum in schools. Therefore, examining learning opportunities and outcomes in science education in schools across different regions can provide critical perspectives into environmental sustainability education.

The research literature offers valuable insights into education for environmental sustainability and the teaching of specific environmental topics across different education systems and educational levels. Education systems often compare their approaches and practices when introducing new strategies, as seen in a comparative study of education for sustainable development in Croatia, Montenegro and Serbia (Vukić et al., 2021). However, there is limited evidence on students' environmental knowledge, particularly in the early years of education. For instance, a study from Momete and Momete (2021) attempting to develop a method for tracking progress

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in education for sustainable development across the European Union, focusing on how education systems are meeting Sustainable Development Goals, included information about environmental knowledge. European Union education systems were grouped into higher and lower achievers based on educational indicators. However, the primary knowledge indicators used did not specifically assess sustainability knowledge, competencies, or attitudes. Instead, they measured the general science competencies of 15-year-old students as reported in the Organisation for Economic Co-operation and Development's PISA¹ study (Momete & Momete, 2021). A recent systematic review of studies on environmental sustainability competencies in primary education (Cebrián et al., 2025) examined existing approaches and tools assessing sustainability competencies but did not address student knowledge directly. The review identifies a range of pedagogical strategies used to assess knowledge, competencies and outcomes, primarily within interdisciplinary environmental learning activities for students in different age groups. It highlights the need for greater evidence to inform educators about the current state of education for environmental sustainability with regard to student knowledge and competences (Cebrián et al., 2025).

Key predictors of environmentally responsible behavior include attitudes and social norms, both of which are expected to be closely linked to environmental knowledge, according to educational research (Reynolds & Komakhidze, 2022). Increased knowledge can enhance motivation for engagement, while active participation can, in turn, deepen knowledge. The overarching goal of education for environmental sustainability is to equip students—and future adults—with the knowledge and motivation needed to take action in preserving the environment and promoting sustainability. Consequently, the relationship between knowledge acquired in school and the development of attitudes is crucial. Baierl et al. (2024) found that students' attitudes toward nature influenced the levels of knowledge they gained and retained. Earlier research also demonstrated that students' motivation for environmental engagement varies according to age and school grade level (Liefländer & Bogner, 2014). To develop effective strategies for fostering long-term motivation, it is essential to understand how knowledge shapes engagement and how these dynamics differ across education systems and cultural contexts from an early age.

In Chaps. 1 and 2 of this volume, existing and emerging opportunities to learn environmental sustainability are examined through GreenComp, the reference framework for sustainability competences in the European Union, alongside additional frameworks available across Europe (Bianchi et al., 2022). Understanding the relationship between knowledge and attitudes—while considering the opportunities students have to learn—represents a crucial next step in developing effective strategies to enhance sustainability education and promote a deeper understanding of environmental issues.

The central purpose of this chapter is to explore how education for environmental sustainability is implemented in European education systems, based on research of student knowledge. In 2023, most European education systems took part in the Trends

¹PISA = Programme for International Student Assessment.

in International Mathematics and Science Study (TIMSS) 2023, which assessed students' environmental knowledge and attitudes, and factors influencing their learning opportunities. TIMSS is a complex curriculum-based study which collects evidence from multiple sources while maintaining connections between them, enabling the interpretation of all collected data to the measured student achievement within representative samples from each participating education system.

4.1.1 The TIMSS Curriculum Model Behind the Data on Education for Environmental Sustainability

Among international large-scale assessments, TIMSS 2023 is the most extensive curriculum-based study of science knowledge (von Davier, Kennedy, et al., 2024). Conducted in 4-year cycles, TIMSS measures students' knowledge, based on a selected set of contents and topics that students in all participating education systems are generally expected to have the opportunity to learn in school (achievement data). In addition to achievement data, TIMSS collects contextual data to explain differences in students' learning opportunities and measured knowledge. The contextual data is gathered from multiple sources—including national representatives, schools, teachers and students—through questionnaires and national reports. The focus of this chapter is specifically on environmental achievement and curricular data for the target population of grade four students in European education systems.

4.1.2 Contents of Environmental Achievement Tests

For each study cycle, the participating education systems together select contents and topics that form the basis of the common achievement tests. These are documented in the TIMSS assessment frameworks (Mullis et al., 2021) and are used to develop the assessment items that make up the student achievement tests. In TIMSS 2023, there were 44 assessment items aligned with 14 environmental sustainability topics (Table 4.1).

4.1.3 Curricular Data

TIMSS is structured around three curricular levels: the intended curriculum, the implemented curriculum, and the attained curriculum (Fig. 4.1). At each level, different data on environmental sustainability are collected in a way that allow them to be related to student achievement, which is the focus of the study.

Table 4.1 Environmental contents assessed in TIMSS 2023

| Content | Topics |
|------------------|--|
| Earth science | |
| ES/ ECH/1A | Physical characteristics of the Earth system: Recognize that Earth's surface is made up of land and water in unequal proportions (more water than land) and is surrounded by air; describe where fresh and salt water are found |
| ES/ ECH/2A | Earth's resources: Identify some of Earth's resources that are used in everyday life (e.g., water, wind, soil, forests, oil, natural gas, minerals) |
| ES/ ECH/2B | Earth's resources: Explain the importance of using Earth's renewable and nonrenewable resources responsibly (e.g., fossil fuels, forests, water) |
| ES/ ECH/3B | Earth's history: Recognize that some remains (fossils) of animals and plants that lived on Earth a long time ago are found in rocks and ice and make simple deductions about changes in Earth's surface from the location of these remains |
| ES/ ECH/1B | Weather and climates on Earth: Describe how weather (i.e., daily variations in temperature, humidity, precipitation in the form of rain or snow, clouds, and wind) can vary with geographic location |
| ES/ ECH/1C | Weather and climates on Earth: Describe how average temperature and precipitation can change with the seasons and location; recognize that the average temperature on Earth has increased over the last century and some effects of this increase on Earth's physical characteristics (e.g., ocean levels have increased, ice caps have melted, rivers have dried up, deserts have grown bigger) |
| Life science | |
| LS/ Eco/1A | Common ecosystems: Relate common plants and animals (e.g., evergreen trees, frogs, lions) to common ecosystems (e.g., forests, ponds, grasslands) |
| LS/ Eco/2A | Relationships in simple food chains: Recognize that plants need (sun)light, air, and water to provide energy for life processes (i.e., growth and repair, movement, and reproduction); explain that animals eat plants or other animals to get the food they need to supply energy for life processes (i.e., growth and repair, movement, and reproduction) |
| LS/ Eco/2B | Relationships in simple food chains: Complete a model of a simple food chain using common plants and animals from common ecosystems, (e.g., a forest, a desert, a river, an ocean) |
| LS/ Eco/2C | Relationships in simple food chains: Describe the roles of living things at each link in a simple food chain (e.g., plants produce their own food; some animals eat plants, while other animals eat the animals that eat plants) |
| LS/ Eco/2D | Relationships in simple food chains: Identify common predators and their prey and describe their relationships |
| LS/ Eco/3A | Competition in ecosystems: Recognize and explain that some living things in an ecosystem compete with others for resources (e.g., food, light, space) |
| LS/ OEI/3A | The impact of humans on the environment: Recognize that human behavior has negative and positive effects on the environment (e.g., negative effects of air and water pollution, positive effects of reducing air and water pollution); provide general descriptions and examples of the effects of pollution on humans, plants, and animals |
| Physical science | |
| PS/ EN/1A | Common sources and uses of energy: Identify sources of energy (e.g., the Sun, flowing water, wind, coal, oil, gas), and recognize that energy is needed for movement and transportation, manufacturing, heating, lighting, and powering electronic devices |

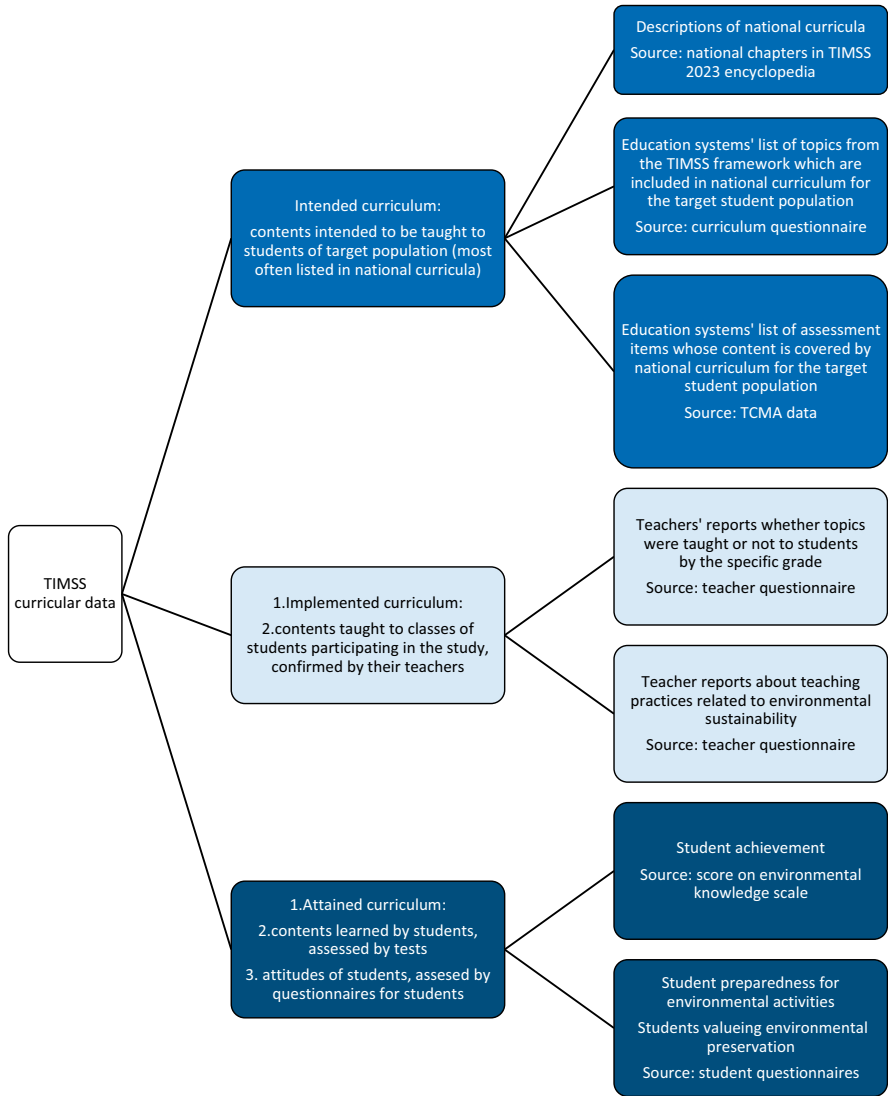


Fig. 4.1 Model of data sources for teaching the environmental sustainability contents

The intended curriculum refers to the topics intended to be taught in schools and is based on information collected on the national level. Each participating education system is asked to provide a national chapter to the TIMSS 2023 encyclopedia (Reynolds et al., 2024), presenting an overview of their mathematics and science education. The chapters follow a similar structure and, among other information, provide summaries of the science curriculum up to grade four and grade eight. These summaries offer a broad perspective on the national curricula, beyond the specific environmental

sustainability topics examined in TIMSS. Further, education systems' responses to the curriculum questionnaire (Reynolds et al., 2024), report whether each specific topic from the TIMSS framework is included in the national curriculum for all students, advanced students, or not included at all. More precise data are also collected through the Test Curriculum Matching Analysis (TCMA) (Fishbein et al., 2025), in which education systems report whether the contents or topics of each assessment item used in the study are explicitly covered in their national curricula.

The implemented curriculum refers to the topics actually taught in schools and is measured through teachers' responses on whether students had the opportunity to learn each topic from the TIMSS framework before participating in the TIMSS assessment. For environmental sustainability topics, science teachers of participating students indicated, in their teacher questionnaire, whether each topic had been taught in previous years, during the year of assessment, or had not yet been taught. Data are reported as the percentage of students who have been taught each topic in previous years, in the assessment year, or not at all, by education systems.

The attained curriculum refers to what students actually learned and can demonstrate. In relation to environmental sustainability, it is observed at the student level through scores students achieved on the scale of environmental knowledge (von Davier, Fishbein, et al., 2024). These scores can be compared between students who, according to teacher reports, had been taught specific content and those who had not. In addition, teacher reports about teaching practices related to environmental sustainability added insight into how students' knowledge and attitudes are developed.

Students' preparedness for environmental activities was evaluated based on self-reported engagement in environmentally responsible behaviors. Environmental awareness was assessed by asking students about their feelings toward nature, with responses used to construct the Students Value Environmental Preservation scale (von Davier, Kennedy, et al., 2024).

4.1.4 Student Achievement in Environmental Knowledge

Focusing on student achievement, students' achievement in environmental knowledge can be examined by education system. This reveals relatively large differences between systems, with no clear geographic pattern apparent on the scale (Table 4.2).

Table 4.2 Mean student score on the scale of environmental knowledge

| Education system | Mean | SE | Education system | Mean | SE |
|------------------|--------|--------|------------------------|--------|--------|
| Poland | 556.91 | (2.56) | Serbia | 517.03 | (3.26) |
| Finland | 543.10 | (3.37) | Germany | 512.85 | (3.19) |
| Ireland | 536.17 | (3.94) | Spain | 510.15 | (2.64) |
| Denmark | 535.70 | (3.58) | Slovak Republic | 509.00 | (4.46) |
| Hungary | 533.07 | (4.24) | Latvia | 503.78 | (3.48) |
| Bulgaria | 532.60 | (5.84) | France | 495.70 | (4.03) |
| Sweden | 527.70 | (3.81) | Belgium (Flemish) | 491.70 | (3.56) |
| Romania | 525.40 | (5.97) | Belgium (French) | 482.74 | (3.09) |
| Lithuania | 520.47 | (3.32) | Cyprus | 479.67 | (3.18) |
| Czech Republic | 520.15 | (3.07) | Albania | 478.18 | (6.25) |
| Slovenia | 520.02 | (3.03) | Montenegro | 465.20 | (2.59) |
| Netherlands | 518.91 | (3.05) | Bosnia and Herzegovina | 448.45 | (5.07) |
| Portugal | 518.39 | (3.64) | N. Macedonia, Rep. of | 436.86 | (5.64) |
| Italy | 517.06 | (2.72) | Kosovo | 402.39 | (4.08) |

Table average: 504.98 (0.75)

Note: SE, standard error

4.1.5 Aim of the Study

The aim of this chapter is threefold. First, it introduces the reader to the complex landscape of TIMSS curricular and achievement data. Second, it presents the results of analyses that explore patterns, relationships and comparisons in environmental sustainability education across European education systems. Finally, the chapter seeks to provide insight into students' opportunities to learn about environmental sustainability, their knowledge and attitudes toward it, and the relationship between these factors.

4.1.6 Research Questions

The main research questions addressed in this study are:

1. How do national curricula, teaching approaches, and student outcomes in education for environmental sustainability vary across European education systems?
2. How do the prescribed content and the content taught relate to student outcomes?
3. Is higher student environmental knowledge linked to more positive attitudes toward environmental sustainability?
4. Are there groups of European education systems that share similarities in teaching approaches, student knowledge, and attitudes toward environmental sustainability?

4.2 Data Sources and Methods

The data sources for this study consisted of national reports and three TIMSS 2023 datasets from participating European education systems. Analysis was conducted of TIMSS 2023 encyclopedia chapters, curricular data, and achievement and attitudinal data of grade four students, along with teacher-reported data, across 28 education systems: Albania, Belgium (Flemish), Belgium (French), Bosnia and Herzegovina, Bulgaria, Cyprus, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Kosovo, Latvia, Lithuania, Montenegro, the Netherlands, the Republic of North Macedonia, Poland, Portugal, Romania, Serbia, the Slovak Republic, Slovenia, Spain, and Sweden.

4.2.1 *Intended Curricula*

The analysis of intended curricula involved four steps:

1. Extracting information on environmental sustainability contents in science curricula from the national chapters of the TIMSS 2023 encyclopedia.
2. Reviewing data from the curricular questionnaire to determine which observed environmental sustainability topics were covered for all students, some students, or not at all in national curricula.
3. Analyzing TCMA data to compare education systems by assessment items, with regard to whether their content was covered in national curricula. To identify patterns across education systems, hierarchical clustering using the Ward method was applied, highlighting similarities between systems in including environmental sustainability contents in their curricula.
4. Relating coverage of environmental sustainability content in intended curricula with student mean achievement in environmental knowledge, by education system.

4.2.2 *Implemented Curricula*

The analysis of implemented curricula involved three steps:

1. Comparing the extent of topics taught, as reported by teachers, by education system.
2. Relating information about topics taught with student achievement in environmental knowledge. Student groups were compared based on whether they had been taught the topics before or during the assessment year, or not yet, analyzing differences in group size and mean achievement.

3. Reviewing teacher reports on the use of teaching practices related to environmental sustainability and linking them to student achievement. Patterns of promoting environmental activities by education system were examined:
 - (a) Frequency of engagement in specific activities in lessons, such as developing students' positive attitudes toward the natural environment, encouraging resource conservation (for example, water, energy), discussing how students' actions inside and outside of school can help the environment, and addressing environmental issues like climate change and endangered species.
 - (b) Involvement of students in activities like visiting natural areas, participating in environmentally responsible actions (for example, picking up trash), conducting research or projects on environmental topics (for example, pollution, climate change), and providing opportunities for students to engage in outdoor environmental education programs outside of school.

4.2.3 *Attained Curricula*

The analysis of attained curricula focused on student attitudinal and achievement data. TIMSS was designed to assess students' attitudes toward the natural environment and their engagement in environmentally responsible behaviors. Students were asked two sets of questions: how much they agree with specific statements about their relationship with the natural environment, and how frequently they take actions to help it. The responses to the first set of statements were used to create the Students Value Environmental Preservation scale, with an international mean score of 10 points. The second set of questions provided data on the frequency of students' environmental activities.

To explore the connection between attitudes toward environmental sustainability and environmental knowledge, the following analyses were conducted:

- Correlation analyses between environmental knowledge and student attitudes toward environment.
- A regression analysis of the Students Value Environmental Preservation scale and achievement in environmental knowledge.
- Comparisons between education systems of students' actual engagement in environmentally friendly activities.

To ensure accurate calculations, TIMSS-prescribed procedures were followed for computing mean student achievement, using the International Association for the Evaluation of Educational Achievement (IEA) IDB (International Database) Analyzer (IEA, 2021) with SPSS (IBM, 2021) to correctly handle plausible values for achievement scales and account for sampling errors (Fishbein et al., 2025).

4.3 Results

4.3.1 Level of Intended Curricula

4.3.1.1 Extracting Information on Environmental Sustainability Content in Science Curricula

The review of national science curricula from the TIMSS 2023 encyclopedia (Reynolds et al., 2024) provides a general overview of intended curricula for teaching environmental sustainability (Table 4.3). There is a notable degree of variation in education systems' reports. In some systems, topics are allocated to different grades, others report only the general contents requested by grade four.

Table 4.3 Summary of content prescribed in national curricula related to environmental awareness and sustainability

| Education system ^a | Summary from TIMSS 2023 encyclopedia on environmental awareness and sustainability topics included in national curricula |
|-------------------------------|--|
| Poland | The core curriculum emphasizes the need to organize activities that support perceiving the natural environment and exploring it, learning the values and inter-relationships of components of the natural environment, learning the values and norms that source a healthy ecosystem, and developing behaviors resulting from these values |
| Finland | <i>Building a Sustainable Future</i> unit: Students study biodiversity, climate change, and its mitigation; sustainable use of natural resources; promoting health; caring for one's own cultural heritage; living in a multicultural world; and the global well-being of humanity now and in the future. Students take part in a collaborative project in which they practice participation and involvement at the local or global level |
| Ireland | <i>Environmental Awareness and Care</i> is one of four content strands, subdivided into three units <i>Environmental Awareness</i> : identify positive aspects of natural and built environments; identify the interrelationship of living and nonliving elements of local and other environments; become aware of the importance of Earth's renewable and nonrenewable resources; recognize how people's actions affect their environment; come to appreciate the need to conserve resources <i>Science and the Environment</i> : begin to explore and appreciate the application of science and technology in familiar contexts; identify some ways in which science and technology contribute positively to society; recognize and investigate human activities that have positive and negative effects on local and wider environments <i>Caring for the Environment</i> : examine a number of ways in which the local environment could be improved or enhanced; identify and discuss a local, national, or global environmental issue; realize that there is a personal and community responsibility for taking care of the environment |
| Denmark | The science subject should develop students' understanding of human interaction with nature and encourage them to engage and act in ways that support sustainable development |
| Hungary | <i>Integrated Natural Sciences</i> subject: explaining the importance of a sustainable lifestyle by using examples, interpreting the role of tradition in building a harmonic connection with nature |

(continued)

Table 4.3 (continued)

| | |
|-------------------------------|---|
| Education system ^a | Summary from TIMSS 2023 encyclopedia on environmental awareness and sustainability topics included in national curricula |
| Bulgaria | Identify common environmental pollutants; identify human actions that can affect the balance of nature and describe possible courses of action for environmental protection |
| Sweden | Grades four to six: <i>Nature and Environment</i> as part of core content—human dependence on and impact on nature, with links to the use of natural resources, sustainable development, and ecosystem services; nature as a resource and our responsibilities when using it |
| Romania | Grades three to four: General aim—develop an interest in and feel responsible for environmental sustainability; curriculum knowledge standard—Basic competencies in science and technology: exhibit interest in one’s own health and in a clean environment; apply basic rules for personal hygiene and rules for responsible behavior toward the environment |
| Lithuania | <i>Humans and Nature</i> content area: recognize that the environment and natural phenomena (sunlight, air, and water) help sustain life |
| Czech Republic | <i>Diversity of Nature</i> thematic area with <i>Conservation and protection</i> topic: human responsibility toward the environment, conservation, and protection of the environment; waste disposal; natural and ecological disasters |
| Slovenia | Grades one to three: environmental pollution, consequences of pollution on living things, waste management, pollutants of water, soil, air, energy saving, environmental management |
| Netherlands | The eight core objectives are focused on natural science, technology, and health-related topics. They provide a general overview of skills and knowledge, including having an investigative attitude toward nature, connecting theories and models with practical work, and promoting sustainability |
| Portugal | One of six themes: discovering relations between nature and society |
| Italy | Grade three: <i>Man, Living Things, and the Environment</i> content area—recognize needs in different living organisms, similar to those of humankind, with respect to their environment; and, <i>Observing and Experimenting in the Field</i> content area—observe and understand the environmental changes generated by nature (e.g., sunlight, weathering, water) and by humankind (e.g., urbanization, cultivation, industrialization) |
| Serbia | Grade three: Expected outcomes—illustrate with examples responsible and irresponsible attitudes of humans toward the environment; explain how recycling helps to preserve nature |
| Germany | <i>Environment and Sustainability</i> topic: identify possibilities for waste prevention and prepare a guidebook for this purpose; investigate and discuss the importance and use of resources and test their careful use (e.g., water, energy, soil, air, paper) |
| Spain | <i>The Living Things</i> content block with topics: relationship between living things; characteristics and components of an ecosystem From the 2023–2024 academic year, <i>Knowledge of the Natural, Social, and Cultural Environment</i> subject with topic: identify the causes and consequences of human intervention in the environment from social, economic, cultural, technological, and environmental perspectives in order to improve one’s ability to face problems and to implement sustainable lifestyles that are consistent with respect for, care for, and the protection of people and the planet |

(continued)

Table 4.3 (continued)

| | |
|-------------------------------|---|
| Education system ^a | Summary from TIMSS 2023 encyclopedia on environmental awareness and sustainability topics included in national curricula |
| Slovak Republic | Under theme <i>Plants</i> , the topics: germination, vegetative reproduction, conditions for plant growth, effects of water and light on plants, diversity of plants, pollinators, lifespan of plants, effects of environmental changes |
| Latvia | <i>Interaction of Man and Environment</i> subject, with topics: Learn to identify protected natural objects in the nearest vicinity, acknowledge experience to care for living beings and be aware of the necessity of taking care of living beings, observe the norms of behavior in nature (e.g., protected areas), learn to safely collect mushrooms and herbs New (2022): What are natural resources and how are they used? Raise awareness of renewable and non-renewable natural resources, how they can be used, and the need to conserve them |
| France | Grades four to six: Each of four main themes, (1) <i>Matter, Movement, Energy, Information</i> ; (2) <i>Living Things, Their Diversity, and Their Functions</i> ; (3) <i>Technical Materials and Objects</i> ; and (4) <i>Planet Earth—Living Beings in Their Environment</i> enables the construction of concepts or notions that find their application in education for sustainable development. The theme <i>Planet Earth—Living Beings in Their Environment</i> includes the topic: identify issues related to the environment |
| Belgium (Flemish) | <i>Nature</i> domain: The students can independently perform basic actions in the care of animals and plants in their environment; The students show in their behavior a willingness to handle waste, energy, paper, food, and water carefully in their class and school; The students can illustrate with concrete examples from their environment how people deal with the environment positively and negatively; The students can illustrate with concrete examples from their environment that conflicting interests often underlie environmental problems; The students show respect and care for nature, understanding that human needs depend on the natural environment |
| Belgium (French) | Knowledge domain of <i>People and the Environment</i> : The main objective is to act in an informed manner for the benefit of all people and science teaching contributes to the development of skills. Environmental education (management, conservation, protection, use of resources and destruction, pollution, etc.) should not be certified but rather focused on constantly raising awareness |
| Cyprus | <i>Life Science</i> subject: Cyprus ecosystems and the importance of their conservation |
| Albania | Sustainability contents are not explicitly mentioned |
| Montenegro | <i>Life cycles</i> topics: understand the correlation between people's activities and pollution; understand man's impact on water conservation and consumption; understand the importance of protecting the air |
| Bosnia & Herzegovina | Sustainability contents are not explicitly mentioned |
| N. Macedonia, Rep. of | Natural resources and their protection (natural resources, air, water, soils, forests, mineral resources, coal, oil, natural/terrestrial gas, sun, water, wind, non-renewable sources of energy, renewable energy sources, recycling) |
| Kosovo | Sustainability contents are not explicitly mentioned |

Note: ^aEducation systems are ordered according to the national mean student achievement in environmental knowledge; see Table 4.2. If a grade is not mentioned, it is reporting grade four results

4.3.1.2 Reviewing Data from the Curricular Questionnaire: Topics from the TIMSS Framework Intended to be Taught

The analysis of coverage of observed environmental sustainability contents from the TIMSS framework in national curricula shows more comparable results (Tables 4.4 and 4.5). For some topics, education systems reported combined coverage of sets of topics.

Summaries of coverage of environmental sustainability content in national curricula reveal distinct approaches across education systems to integrating environmental topics into curricula. While a few systems do not explicitly mention environmental content in the TIMSS 2023 encyclopedia, nearly all education systems emphasize teaching the importance of care for the natural environment, understanding human impact on nature, addressing pollution and waste management, and fostering positive attitudes toward sustainability. Although the term *sustainability* is not explicitly used in many national reports, it is likely incorporated in school teaching, given that the reports are summaries and may not capture all details.

Regarding content and topics from the TIMSS framework, some are intended to be taught in most education systems, at least to advanced students (for example, positive and negative impacts of humans on the environment), while others appear in only a few systems (for example, competition in ecosystems, and fossils and

Table 4.4 Life and physical science topics reported by education systems as included in curriculum

| Topics as reported by education systems ^a | The positive and negative impacts of humans on the environment; LS/OEI/3A | Plants and animals in common ecosystems; LS/Eco/1A | Relationships in simple food chains; LS/Eco/2A, LS/Eco/2B, LS/Eco/2C, LS/Eco/2D | Competition in ecosystems; LS/Eco/3A | Common sources of energy; PS/EN/1A |
|--|---|--|---|--------------------------------------|------------------------------------|
| Poland | Advanced | None | All | None | None |
| Hungary | All | All | None | None | All |
| Finland | All | None | All | None | None |
| Slovenia | All | All | None | None | None |
| Belgium (Flemish) | Advanced | Advanced | Advanced | None | Advanced |

– Education systems where all observed topics are intended to be taught to all students: Albania, Bulgaria, Denmark, France, Germany, Italy, Kosovo, Latvia, Lithuania, Montenegro, Portugal, Romania, Serbia, Spain, and Sweden

– Education systems where competition in ecosystems is not intended to be taught to any students and four other topics to all students: Belgium (French), Bosnia and Herzegovina, Cyprus, the Czech Republic, Ireland, the Republic of North Macedonia, and the Slovak Republic

Notes. ^aEducation systems are ordered according to the national mean student achievement in environmental knowledge; see Table 4.2. All: taught to all students; advanced: taught to advanced students only; none: not taught. The Netherlands was excluded from the analysis

Table 4.5 Earth science topics reported by education systems as included in curriculum

| Topics as reported by education systems ^a | Physical characteristics of Earth; ES/ECH/1A | Earth's renewable and non-renewable resources; ES/ECH/2A, ES/ECH/2B | How weather can vary across geographic locations and seasons; ES/ECH/1B | Earth's rising average temperatures and results of this change; ES/ECH/1C |
|--|--|---|---|---|
| Finland | None | None | All | None |
| Ireland | None | All | None | None |
| Hungary | All | All | None | None |
| Czech Republic | All | All | All | Advanced |
| Slovenia | All | None | All | None |
| Germany | All | All | All | Advanced |
| Spain | All | None | All | None |
| Slovak Republic | All | None | All | None |
| France | All | All | None | All |
| Belgium (Flemish) | All | Advanced | All | Advanced |
| Belgium (French) | All | None | All | None |
| Bosnia and Herzegovina | All | None | All | Advanced |
| N. Macedonia, Rep. of | All | All | None | None |
| Kosovo | All | All | All | None |

– Education systems where all observed topics, including fossils, are intended to be taught to all students: Denmark, Italy, and Romania

– Fossils and what they show about Earth's history are not intended to be taught to any students in all other education systems

– All four topics except fossils and what they show about Earth's history were taught in Latvia, Lithuania, Portugal, Serbia and Sweden

– All three topics except fossils and Earth's rising average temperatures and results of this change are taught in Bulgaria, Cyprus, Kosovo and Montenegro

– All five topics were not intended to be taught to any students in Albania and Poland

Notes. ^aEducation systems are ordered according to the national mean student achievement in environmental knowledge; see Table 4.2. All: taught to all students; advanced: taught to advanced students only; none: not taught. The Netherlands was excluded from the analysis

what they show about Earth's history). Overall, the Earth science topics are less frequently included in national curricula compared to life and physical science topics. In almost one third of education systems, more than half of the Earth science topics (three or more out of five) are not covered in the national curricula at all.

The least taught topic (after fossils) is Earth's rising average temperature and results of this change, which is directly linked to the environmental sustainability problem of climate change. This topic is taught in only 9 education systems to all students, in 4 education systems to advanced students, but in 14 education systems to no students at all. In Finland and Ireland, general climate change content is explicitly included into their summaries of curriculum, but as a specific topic it

is marked as not intended to be taught to the same population of students, revealing the potential differences in transforming national curricula into teaching of specific content.

4.3.1.3 Analyzing Test Curriculum Matching Analysis (TCMA) Data: Assessment Items' Content Coverage in National Curricula

The third and most precise source of information about intended curricula is the national list of assessment items identified as being covered in each national curriculum, meaning that students are intended to be taught the content and concepts that are needed to solve items correctly. Of the 28 education systems, 2 systems—Bulgaria and Cyprus—did not provide data for this analysis. For the remaining 26 education systems, content coverage for each of the 44 items forming the environmental knowledge scale was analyzed. Education systems were then grouped into four distinct clusters based on similarities in intention to teach the contents of the environmental knowledge scale items:

- The largest cluster—with the greatest number of shared scale items intended to be taught—includes half of the education systems: Belgium (French), Bosnia and Herzegovina, Denmark, France, Germany, Ireland, Italy, Lithuania, Montenegro, the Republic of North Macedonia, Portugal, Romania, Serbia, and Sweden.
- The second cluster includes four education systems: the Czech Republic, Latvia, the Netherlands, and Spain.
- The third cluster includes three education systems: Albania, Finland, and the Slovak Republic.
- The fourth cluster—with the fewest number of shared scale items intended to be taught—includes five education systems: Belgium (Flemish), Hungary, Kosovo, Poland and Slovenia.

The assignment of education systems to clusters shows no geographical pattern (for example, Latvia and the Netherlands appear in the same cluster) and no direct relationship to mean student achievement (for example, Albania and Finland appear in the same cluster).

In general, the results align with education systems' reports on coverage of content and topics in national curricula. Systems in the fourth cluster tend to report less intended teaching of environmental topics, as reflected in their curriculum analysis reports (Tables 4.4 and 4.5). For example, Poland reported almost all TIMSS topics were not intended to be taught, while Belgium (Flemish) indicated that almost all topics were intended for advanced students only.

However, not all education systems in this group show consistent results from the two analyses. For example, the Czech Republic reported that almost all TIMSS topics were covered by the curriculum, including sources of energy, yet items asking about the use of these sources of energy were not identified as being intended to be taught. This discrepancy highlights the potential problem of

overgeneralization: curriculum documents may specify broad content areas, while the specific concepts tested by individual items are not always intended to be taught. This suggests that while parts of the observed topics might be presented to students, the full scope of the content may not be consistently included, underscoring limitations in the precision of curriculum descriptions and assessments.

Reviewing the item coverage for one education system from each cluster, focusing on items that differ in coverage between clusters, provides further insight into the characteristics of each cluster (Table 4.6).

4.3.1.4 Relations to Student Achievement

The analysis of student knowledge indicated that mean national student achievement in environmental knowledge is not directly related to the number of items covered in the curricula of education systems (Fig. 4.2). In general, the mean achievement of education systems in Cluster 4, which cover the fewest items, is not lower than the mean achievement of education systems in Clusters 2 or 3, which cover a larger number of items and concepts in their curricula. For example, Poland has the highest achievement but covers almost the fewest items. Finland shows coverage of 31 items and achieves a high score of over 500. Italy and the Republic of North Macedonia have the highest coverage of items, yet there is a large difference in student environmental knowledge between the two systems (Fig. 4.2).

The results clearly indicate that simply covering content in the curriculum does not always lead to higher student knowledge.

4.3.2 Level of Implemented Curricula

4.3.2.1 Comparing the Extent of Topics Taught in Schools

Implemented curricula—the contents actually taught in classes—were measured through teachers' reports indicating when topics from the TIMSS framework were taught to their assessed students.

The results reveal that, in many education systems, teachers report different levels of curriculum coverage than national reports. For topics that national reports indicated were not intended to be taught, teachers confirmed teaching them to notable percentages of students (Table 4.7). The opposite pattern was also observed: content listed in national curricula was reported by teachers as not being taught to large fractions of students.

For example, Finland, Poland and Spain reported that their national curricula cover the teaching of relationships in simple food chains while Hungary and Slovenia do not. In practice, teachers in Poland reported that 86% of students were taught this content in the years before grade four and almost all remaining students learned this content in grade four. In contrast, in Spain, almost 40% of

Table 4.6 Items and their content coverage by curricula

| Item | Topic | Coverage | LVA | CZE | FIN | POL |
|----------|--|----------|-----|-----|-----|-----|
| SE81168 | Why plastic objects dangerous | 26 | 1 | 1 | | 1 |
| SE81077 | Plant in the cupboard dies | 26 | 1 | 1 | | 1 |
| SE81036 | Decrease air pollution in a city | 24 | 1 | 1 | 1 | |
| SE81044 | Harmful and helpful human activities | 24 | 1 | 1 | 1 | |
| SE81202 | Location of salt water | 24 | 1 | 1 | 1 | |
| SE71071 | Mice increase after trees are cut down | 24 | 1 | 1 | | 1 |
| SE81055 | Human activities that help or harm the environment | 24 | 1 | 1 | | |
| SE81920B | Disadvantages to farming near a river | 24 | | 1 | | 1 |
| SE81920A | Advantages to farming near a river | 24 | | 1 | | 1 |
| SE71201 | What covers Earth's surface | 23 | 1 | 1 | | |
| SE61069 | Plants make their own food | 22 | 1 | 1 | | 1 |
| SE81079 | Grassland food chain | 22 | 1 | 1 | | |
| SE71063 | Animals that live in the desert | 20 | 1 | 1 | 1 | |
| SE81080 | Animals found in a desert | 20 | 1 | 1 | 1 | |
| SE81238 | Effects of increase in Earth's temperature | 20 | 1 | 1 | | |
| SE81054 | Connection between habitat and ape population | 20 | 1 | | | 1 |
| SE81204 | Source of water for a desalination plant | 20 | | 1 | 1 | |
| SE81070 | Predators and prey on the savanna | 19 | 1 | 1 | 1 | |
| SE61116 | Temperature graphs | 19 | 1 | 1 | 1 | |
| SE81239 | Place that with hot, dry weather | 19 | 1 | 1 | 1 | |
| SE71081 | Animal that competes with giraffe for food | 19 | 1 | 1 | 1 | |
| SE61124 | Recycle products made of metal | 19 | | 1 | 1 | |
| SE81212 | Renewable and non-renewable sources of energy | 19 | | | 1 | |
| SE81207B | Energy transformed by turbines | 18 | 1 | | 1 | |
| SE81207A | Energy captured by turbines | 18 | 1 | | | |
| SE71220 | Tropical plant fossil in cold environment | 10 | | | 1 | |
| SE71222 | Fish fossil in the desert | 9 | | | 1 | |

Notes: CZE, Czech Republic; FIN, Finland; LVA, Latvia; POL, Poland; 1, the item is covered by the education system. Coverage refers to the number of education systems which reported the item's content as covered by national curricula. The coverage of all items by each education system is provided in Table 4.11

students were reportedly not taught this content in schools, according to their teachers. Similarly, teachers in Finland reported that about a quarter of students were not taught the content by the time of the TIMSS assessment. In Hungary, where this content is not covered in the national curriculum, the content was nevertheless taught to 62% of students. In Slovenia, where this content is also not

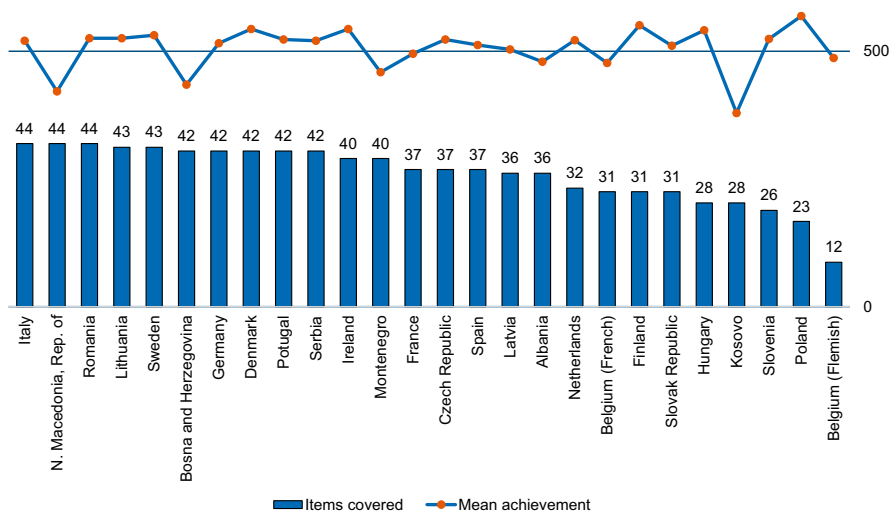


Fig. 4.2 Similar education systems by coverage of items’ contents and student environmental knowledge

Table 4.7 Percentage of students being taught two topics by their teachers in selected education systems

| Education system | Topics taught in schools | Relation- ships in simple food chains | Common sources of energy | Education system | Topics taught in schools | Relation- ships in simple food chains | Common sources of energy |
|-------------------|--------------------------|--|--------------------------------|------------------|--------------------------|--|--------------------------------|
| | | % | % | | | % | % |
| Belgium (Flemish) | Before | 49.3 (5.5) | 12.0 (3.2) | Finland | Before | 47.7 (3.7) | 29.0 (3.3) |
| | This year | 29.2 (4.7) | 55.5 (4.7) | | This year | 24.9 (3.2) | 45.6 (3.7) |
| | Not yet | 21.5 (4.0) | 32.4 (4.3) | | Not yet | 27.4 (3.5) | 25.3 (3.0) |
| Hungary | Before | 32.0 (3.3) | 13.9 (2.3) | Poland | Before | 86.1 (2.4) | 43.0 (4.0) |
| | This year | 39.5 (3.0) | 39.6 (3.6) | | This year | 13.5 (2.4) | 55.4 (3.9) |
| | Not yet | 28.4 (3.2) | 46.5 (3.7) | | Not yet | 0.4 (0.4) | 1.6 (0.7) |
| Slovenia | Before | 25.4 (3.8) | 21.4 (3.0) | Spain | Before | 21.1 (3.3) | 11.2 (2.2) |
| | This year | 55.9 (4.5) | 72.5 (3.2) | | This year | 41.0 (3.8) | 49.5 (4.4) |
| | Not yet | 18.7 (3.1) | 6.2 (1.7) | | Not yet | 37.9 (3.2) | 39.4 (3.8) |

Notes: Standard errors appear in parentheses. Due to rounding some values may seem inconsistent. The results for all education systems are in Table 4.16

covered in the national curriculum, teachers reported that only 19% of students had not been taught the content by the time of the TIMSS assessment. In Belgium (Flemish), this content was intended to be taught to advanced students only, but teachers reported that just 22% of non-advanced students were not taught about relationships in simple food chains.

Additionally, while common sources of energy are not part of the national curricula in Finland, Poland, and Slovenia, only 25% of students in Finland, 2% in Poland, and 6% in Slovenia were reported by teachers as not being taught the topic. In contrast, the majority of students in these education systems received instruction on energy sources either in the assessed or preceding year, according to teacher reports.

4.3.2.2 Topics Taught and Student Achievement

The percentages of students who were taught (before and in grade four) and not taught were examined in relation to their mean achievement across the whole set of content areas and topics on environmental sustainability. Unexpectedly, the differences in mean achievement between the two groups were statistically significant in only a few cases across topics and education systems. For the topics of physical characteristics of Earth and Earth's rising average temperatures, the mean achievement of students not being taught these topics was lower than the achievement of students being taught these topics—though this pattern appeared in only 3 of the 28 education systems for each topic. In one education system (Kosovo), students not being taught these topics scored higher than students who were reported as having been taught them (Table 4.8).

The percentages of students not taught these topics were again lower than expected based on the reports on intended curricula. Although the topic of Earth's rising average temperatures was reported as not included in the national curricula of many education systems, teachers in systems such as Albania, Bulgaria, Finland, Hungary, Ireland, the Republic of North Macedonia and Spain, reported that the majority of students had been taught this content. Conversely, in Belgium (French), Cyprus, Montenegro, Poland, the Slovak Republic, and Slovenia, the majority of students were reported as not having been taught this content.

Similar declines in coverage of intended curricula were observed for the topic of physical characteristics of Earth, which was reported as not being included in the national curricula of education systems such as Albania, Finland, Ireland and Poland. However, the percentage of students not receiving instruction on this topic was relatively low in these systems. In Albania, 50% of students were not taught this content, whereas the figures were considerably lower in Finland (15%), Ireland (25%), and Poland (22%).

Most education systems reported high mean achievement among students learning life science and physical science topics, either in the assessment year or

Table 4.8 Teaching of earth science topics and students' environmental mean scale scores in education systems where difference is significant

| Education system | | Earth science: Physical characteristics of Earth | | | Earth science: Earth's rising average temperatures and results of this change | | |
|-------------------|-----------|--|--------------|------|---|--------------|------|
| | | % | Mean | Sig. | % | Mean | Sig. |
| Belgium (Flemish) | Before | 8.8 (2.5) | 495.1 (6.5) | | 4.5 (1.5) | 499.2 (12.1) | |
| | This year | 23.0 (3.6) | 502.8 (5.7) | | 50.3 (4.1) | 494.9 (5.2) | |
| | Not yet | 68.2 (3.8) | 487.7 (4.0) | * | 45.2 (4.2) | 487.6 (5.2) | |
| Bulgaria | Before | 34.2 (3.6) | 565.3 (8.8) | | 15.4 (2.9) | 552.6 (17.1) | |
| | This year | 55.9 (3.5) | 522.8 (9.7) | | 36.9 (4.1) | 535.1 (11.2) | |
| | Not yet | 9.9 (2.0) | 491.5 (25.8) | * | 47.7 (4.3) | 529.8 (9.7) | |
| Hungary | Before | 21.9 (3.5) | 537.1 (10.8) | | 7.8 (1.8) | 564.0 (8.3) | |
| | This year | 60.1 (4.1) | 534.2 (5.6) | | 48.4 (4.1) | 535.8 (5.3) | |
| | Not yet | 18.0 (3.3) | 523.9 (9.3) | | 43.8 (4.0) | 524.4 (7.4) | * |
| Kosovo | Before | 22.5 (3.6) | 404.8 (7.3) | | 12.5 (2.6) | 392.2 (5.7) | |
| | This year | 51.2 (4.3) | 394.4 (6.0) | | 48.0 (4.4) | 392.3 (6.5) | |
| | Not yet | 26.3 (3.8) | 415.9 (6.6) | * | 39.6 (4.3) | 417.4 (5.6) | * |
| Montenegro | Before | 18.0 (2.4) | 463.6 (6.3) | | 4.1 (0.8) | 452.3 (11.1) | |
| | This year | 55.7 (2.9) | 466.9 (3.5) | | 21.5 (2.4) | 479.7 (5.6) | |
| | Not yet | 26.3 (2.9) | 464.3 (5.1) | | 74.5 (2.5) | 462.4 (2.6) | * |
| Slovak Republic | Before | 31.3 (3.0) | 522.4 (6.6) | | 11.1 (2.0) | 531.8 (9.5) | |
| | This year | 25.3 (2.9) | 508.5 (9.6) | | 30.5 (2.6) | 518.8 (7.0) | |
| | Not yet | 43.3 (3.2) | 499.6 (6.9) | | 58.3 (3.1) | 499.6 (4.9) | * |
| Slovenia | Before | 23.4 (2.8) | 528.6 (5.0) | | 3.0 (1.1) | 519.0 (10.8) | |
| | This year | 47.8 (3.7) | 517.9 (3.5) | | 28.6 (3.3) | 524.5 (4.1) | |
| | Not yet | 28.8 (3.2) | 517.9 (4.2) | * | 68.4 (3.5) | 518.9 (3.3) | |

Notes: Standard errors appear in parentheses. Due to rounding some values may seem inconsistent. The results for all education systems are in Table 4.17

*Significant difference between the mean scale scores at the time of teaching

prior. However, these differences were statistically significant in just a few cases. Education systems with the highest mean achievement for at least one topic—where students were taught the material either in the assessment year or in the previous year—include Montenegro, the Republic of North Macedonia, Portugal, and the Slovak Republic. It should be noted that students may also acquire knowledge about environmental sustainability outside of school settings.

4.3.2.3 Teachers Providing Opportunities to Learn Environmental Sustainability

Science teachers estimated how often they used four specific approaches when teaching environmental sustainability in their lessons: (1) develop students’ positive attitudes toward the natural environment, (2) encourage students to use less resources, (3) discuss how student actions in and outside of school help the natural environment, and (4) discuss environmental issues. On average, teachers in all participating education systems reported using the four observed activities at least once a week or once or twice a month (see Table 4.18).

The frequency patterns of these approaches showed no clear association with the mean achievement of students. The most commonly practiced activity was developing students’ positive attitudes toward the natural environment, reported as being practiced at least weekly in 20 out of 28 education systems. In half of the education systems, teachers also reported weekly encouragement for students to use fewer resources. Discussions about students’ actions and environmental issues were less frequent, although these practices appear most directly related to teaching sustainability content.

Part of teaching sustainability is to engage students in specific activities. Education systems with high student achievement were more likely to include such engagement in activities or practice actions at the local level in their intended curricula, as indicated in the first part of the study. The proportions of students engaged in the four activities, as reported by teachers, varied significantly across education systems—from nearly all students to less than half (Fig. 4.3).

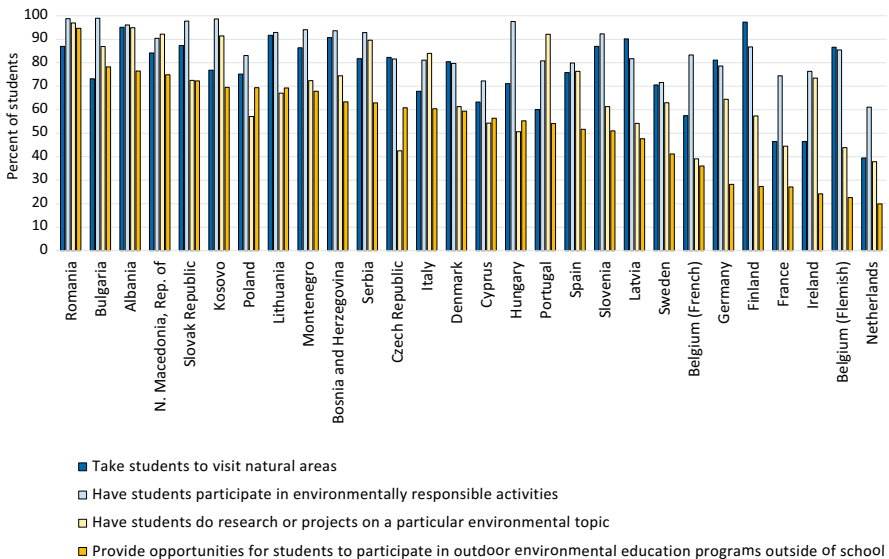


Fig. 4.3 Percentages of students whose teachers reported using different activities to teach about environmental issues and sustainability, by education system

In most education systems, the most common activity is involvement in environmentally responsible activities and the least common activity is providing opportunities to participate in outdoor environmental education programs outside of school. In Albania, Bulgaria, the Republic of North Macedonia, Romania, and the Slovak Republic, more than 70% of students were engaged in all four activities. In contrast, in France and the Netherlands, fewer than 50% of students participated in three of the four activities. It is worth noting that the percentages of students whose teachers reported engaging them in environmentally responsible activities is not aligned with intended curricula in all education systems. For example, Denmark and Ireland intend to include students into local environmental activities but their percentages of students engaged in those activities by their science teachers are not among the highest. The data clearly show the need for more information about who at the school is responsible for engaging students, and how schools engage them, in activities that most likely happen outside classes.

The significant differences in students' environmental knowledge between those who were or were not provided opportunities to participate in these activities are found in the following education systems (difference in number of points)²:

- (a) Take students to visit natural areas: the Slovak Republic (16) and Germany (20).
- (b) Have students participate in environmentally responsible activities: Spain (12), Denmark (19), Montenegro (21), Bosnia and Herzegovina (38), and Bulgaria (61).
- (c) Have students do research or projects on a particular environmental topic (e.g., pollution, climate change): Denmark (11), the Czech Republic (12), Hungary (20), Kosovo (28), and Bulgaria (94).
- (d) Provide opportunities for students to participate in outdoor environmental education programs outside of schools: Germany (19), the Republic of North Macedonia (29), Romania (36), and Albania (42).

In general, education systems where a positive relationship is observed between participation in activities and student achievement are primarily located in Eastern Europe and the Dinaric region. These include Albania, Bosnia and Herzegovina, Bulgaria, the Czech Republic, Hungary, Kosovo, Montenegro, the Republic of North Macedonia, Romania, and the Slovak Republic. In Western Europe, similar patterns are found in Denmark, Germany, and Spain.

An unexpected finding is the notably low percentage of students in Western Europe who are provided with opportunities to participate in outdoor environmental education programs outside of school. The data does not indicate whether such programs are unavailable outside of school or if teachers are simply not responsible for directing students to them. This underscores the need for further investigation into the opportunities available for students outside school to gain a fuller understanding of the situation.

² See Tables 4.12, 4.13, 4.14, and 4.15 for differences in achievement in environmental knowledge between students participating or not in environmental teaching activities provided by teachers for all education systems.

4.3.3 Level of Attained Curricula

4.3.3.1 Attitudes Toward Environment and Environmental Knowledge

The research question regarding attitudes was whether higher student knowledge is linked to more positive attitudes. Higher knowledge could lead to greater appreciation of nature or, conversely, more positive attitudes could motivate students to learn. However, the correlation analysis (Table 4.9) reveals that, in the observed education systems, environmental knowledge is less than moderately linked to student attitudes. Only a few correlations reached at least a moderate level (0.20 and higher). The notable exception is “Addressing climate change should be a high priority,” which is moderately positively correlated with students’ environmental knowledge in 11 education systems. In general, the strongest correlations were found in Denmark, followed by Belgium (Flemish) and Italy. Denmark, Italy, and Romania were the education systems that confirmed all the environmental content topics as being part of their national curricula. In contrast, Belgium (Flemish) reported that nearly all topics were taught only to the advanced students.

Correlations between achievement and agreement with the other three attitudinal statements are very weak or absent in the majority of education systems. Only in a few education systems is higher achievement linked to higher agreement, and this pattern differed across the three statements.

Nevertheless, the regression analysis shows that the Students Value Environmental Preservation scale scores—derived from their agreement to the statements in Table 4.9—generally predict environmental knowledge in all education systems, except four: Bosnia and Herzegovina, Poland, Serbia, and Slovenia (Table 4.10). The strongest association between valuing environmental preservation and

Table 4.9 The correlations between environmental knowledge and student attitudes toward environment

| Addressing climate change should be a high priority | | | | | | | | |
|---|-------|--------|------------------|-------|--------|------------------|-------|--------|
| Education system | Corr. | SE | Education system | Corr. | SE | Education system | Corr. | SE |
| Denmark | 0.27 | (0.03) | Ireland | 0.23 | (0.04) | Germany | 0.20 | (0.02) |
| Belgium (Flemish) | 0.25 | (0.02) | France | 0.20 | (0.02) | Spain | 0.20 | (0.02) |
| Italy | 0.25 | (0.04) | Bulgaria | 0.20 | (0.05) | Lithuania | 0.20 | (0.03) |
| Finland | 0.24 | (0.02) | Netherlands | 0.20 | (0.03) | | | |

| I care about the protection of plants and animals | | | It makes me sad when nature is destroyed | | | I enjoy being in nature | | |
|---|-------|--------|--|-------|--------|-------------------------|-------|--------|
| Education system | Corr. | SE | Education system | Corr. | SE | Education system | Corr. | SE |
| Belgium (Flemish) | 0.20 | (0.03) | Italy | 0.23 | (0.03) | Sweden | 0.24 | (0.02) |
| Slovak Republic | 0.20 | (0.04) | Kosovo | 0.21 | (0.02) | Finland | 0.20 | (0.03) |

Notes: SE, standard error. Correlations lower than 0.20 are not shown. Due to rounding some values may seem inconsistent

Table 4.10 Regression of association between Students Value Environmental Preservation scale and achievement in environmental knowledge

| Education system | Constant | | | Students Value Environmental Preservation | | | | | | |
|------------------------|----------|-----------------|----------------|---|-----------------|-----|------|----------------|----------------|-----------------|
| | B | se _B | t _B | B | se _B | b | b se | t _B | t _b | p |
| Bulgaria | 414.3 | 36.7 | 11.3 | 11.0 | 0.2 | 3.1 | 0.1 | 3.6 | 3.7 | <i>p</i> < 0.05 |
| Albania | 414.0 | 28.4 | 14.6 | 6.7 | 0.1 | 2.5 | 0.0 | 2.7 | 2.7 | <i>p</i> < 0.05 |
| Bosnia and Herzegovina | 475.6 | 21.8 | 21.8 | 2.3 | 0.0 | 2.1 | 0.0 | 1.1 | 1.1 | <i>p</i> > 0.1 |
| Slovak Republic | 437.4 | 20.0 | 21.9 | 7.5 | 0.1 | 1.9 | 0.0 | 3.9 | 4.3 | <i>p</i> < 0.05 |
| Italy | 417.9 | 15.5 | 26.9 | 9.7 | 0.2 | 1.5 | 0.0 | 6.4 | 6.4 | <i>p</i> < 0.05 |
| Romania | 487.1 | 16.9 | 28.9 | 3.7 | 0.1 | 1.5 | 0.0 | 2.5 | 2.5 | <i>p</i> < 0.05 |
| Denmark | 459.4 | 15.0 | 30.6 | 8.5 | 0.2 | 1.4 | 0.0 | 5.9 | 6.1 | <i>p</i> < 0.05 |
| Ireland | 449.9 | 15.9 | 28.2 | 8.4 | 0.2 | 1.4 | 0.0 | 6.2 | 6.3 | <i>p</i> < 0.05 |
| Lithuania | 452.1 | 16.3 | 27.8 | 6.8 | 0.1 | 1.4 | 0.0 | 4.8 | 4.9 | <i>p</i> < 0.05 |
| Slovenia | 500.6 | 14.0 | 35.8 | 2.1 | 0.0 | 1.4 | 0.0 | 1.4 | 1.4 | <i>p</i> > 0.1 |
| N. Macedonia, Rep. of | 326.8 | 14.9 | 22.0 | 111 | 0.2 | 1.3 | 0.0 | 8.4 | 8.5 | <i>p</i> < 0.05 |
| Hungary | 453.4 | 14.6 | 31.0 | 8.1 | 0.2 | 1.3 | 0.0 | 6.3 | 6.7 | <i>p</i> < 0.05 |
| Sweden | 456.3 | 12.9 | 35.5 | 7.7 | 0.2 | 1.3 | 0.0 | 5.8 | 6.1 | <i>p</i> < 0.05 |
| Kosovo | 332.5 | 13.9 | 23.9 | 6.9 | 0.2 | 1.3 | 0.0 | 5.4 | 5.9 | <i>p</i> < 0.05 |
| Portugal | 468.7 | 13.4 | 35.0 | 4.7 | 0.1 | 1.3 | 0.0 | 3.5 | 3.5 | <i>p</i> < 0.05 |
| Serbia | 497.3 | 13.3 | 37.5 | 2.2 | 0.0 | 1.3 | 0.0 | 1.6 | 1.6 | <i>p</i> > 0.1 |
| France | 401.7 | 13.8 | 29.2 | 9.6 | 0.2 | 1.2 | 0.0 | 7.8 | 8.3 | <i>p</i> < 0.05 |
| Latvia | 455.4 | 13.8 | 32.9 | 5.0 | 0.1 | 1.2 | 0.0 | 4.1 | 4.4 | <i>p</i> < 0.05 |
| Belgium (Flemish) | 399.6 | 10.3 | 38.8 | 9.1 | 0.2 | 1.1 | 0.0 | 8.6 | 9.3 | <i>p</i> < 0.05 |
| Finland | 471.8 | 12.0 | 39.3 | 7.5 | 0.2 | 1.1 | 0.0 | 6.9 | 7.4 | <i>p</i> < 0.05 |
| Cyprus | 439.3 | 12.8 | 34.4 | 3.9 | 0.1 | 1.1 | 0.0 | 3.5 | 3.5 | <i>p</i> < 0.05 |
| Belgium (French) | 392.4 | 11.1 | 35.5 | 9.0 | 0.2 | 1.0 | 0.0 | 8.6 | 8.7 | <i>p</i> < 0.05 |
| Germany | 431.8 | 11.0 | 39.1 | 8.4 | 0.2 | 1.0 | 0.0 | 8.4 | 9.0 | <i>p</i> < 0.05 |
| Netherlands | 462.9 | 8.7 | 53.5 | 5.9 | 0.2 | 0.9 | 0.0 | 6.8 | 7.0 | <i>p</i> < 0.05 |
| Poland | 543.9 | 8.7 | 62.4 | 1.4 | 0.0 | 0.9 | 0.0 | 1.6 | 1.6 | <i>p</i> > 0.1 |
| Montenegro | 404.1 | 9.4 | 43.1 | 6.3 | 0.1 | 0.8 | 0.0 | 7.7 | 7.6 | <i>p</i> < 0.05 |
| Czech Republic | 476.7 | 7.5 | 63.8 | 4.5 | 0.1 | 0.8 | 0.0 | 5.7 | 5.7 | <i>p</i> < 0.05 |
| Spain | 443.8 | 8.6 | 51.6 | 6.5 | 0.2 | 0.7 | 0.0 | 9.2 | 10.1 | <i>p</i> < 0.05 |

environmental knowledge is observed in Bulgaria, followed by Albania and the Slovak Republic. The weakest association is seen in the Czech Republic, Montenegro and Spain.

Students were asked to report on their actual activities to help save the environment, including: reuse things and reducing resource usage (for example, water, food); discussing ways to help the environment (for example, saving water, picking up trash); learning about environmental problems (for example, climate change, endangered species); participating in group activities to help the environment; and, informing friends when they are doing things that harm the environment.

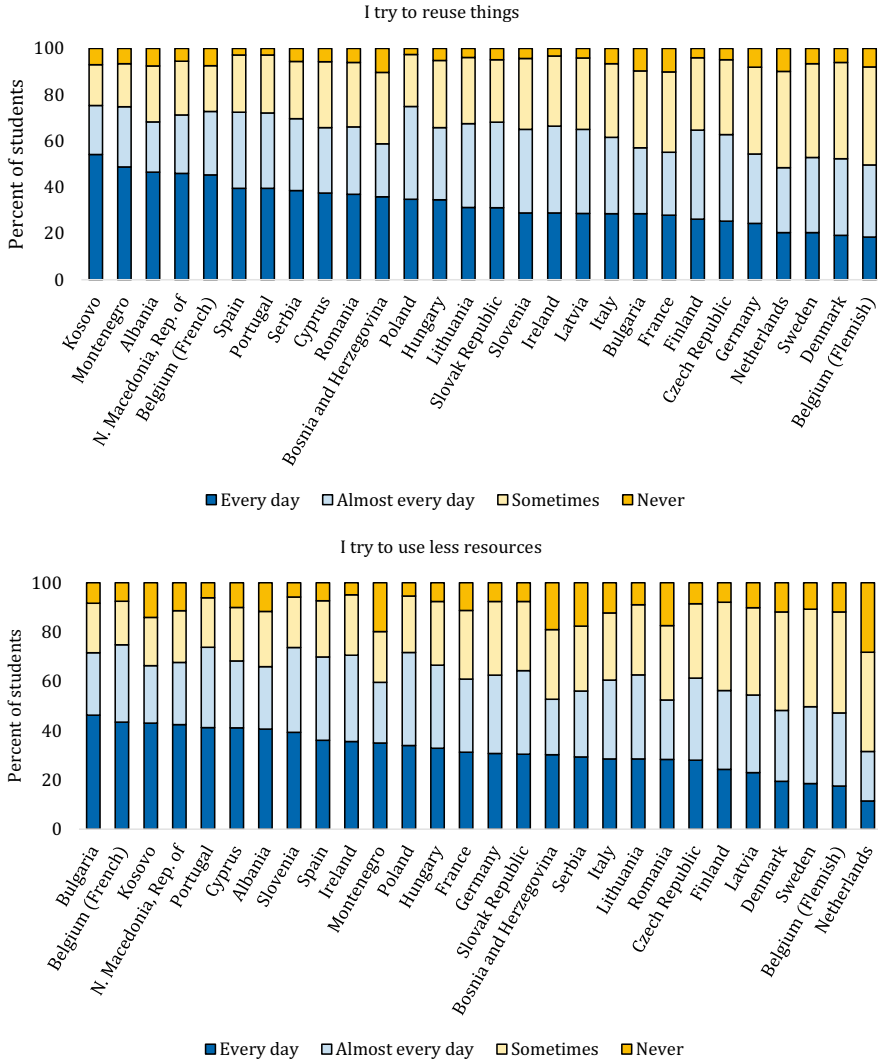


Fig. 4.4 Frequency of student actions: reuse and use less resources

All these activities require a specific level of knowledge to be performed, therefore they are regarded as part of the attained curriculum.

In general, students reported engaging in these activities relatively often (Figs. 4.4, 4.5, and 4.6). The percentage of students who never participated in the observed activities is low in most education systems. The most common activity reported is reusing things, while the least common is participating in group activities to help the environment.

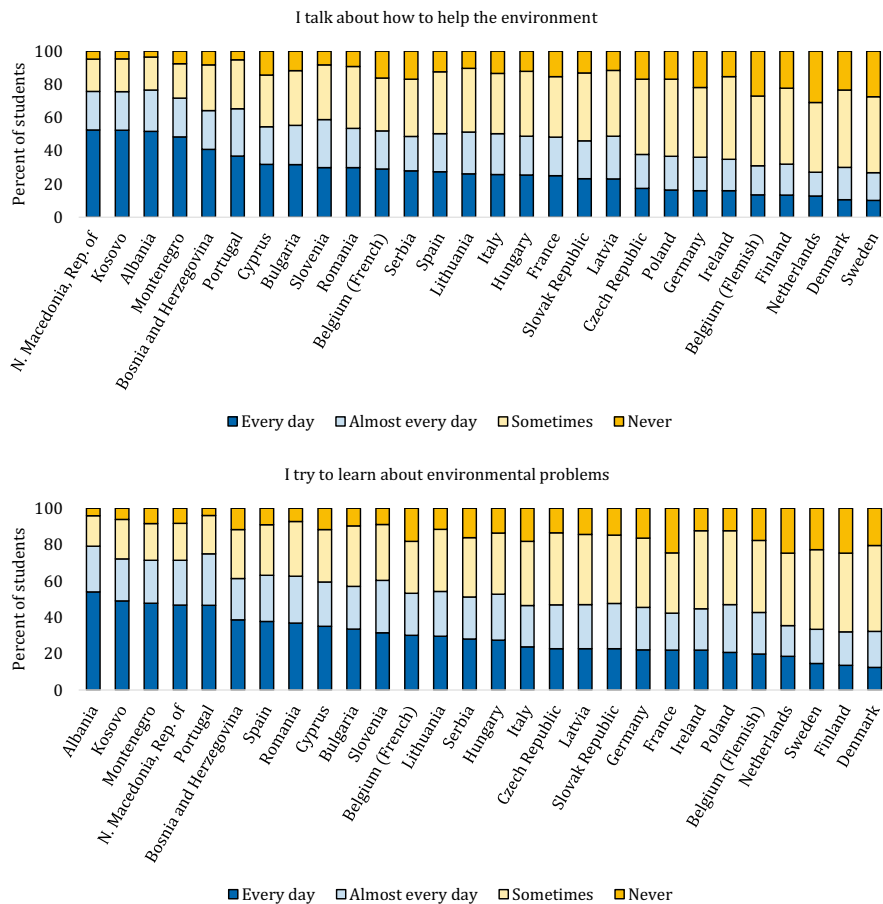


Fig. 4.5 Frequency of student actions: talk and learn about environment

Reusing items is most frequently reported by students in Kosovo, Montenegro, and Albania, while students in Bulgaria, Belgium (French), and Kosovo are the most likely to try to use fewer resources, with around 70% of students engaging in these behaviors every day or almost every day. On the other hand, students in Belgium (Flemish), Denmark, the Netherlands, and Sweden—education systems within the European Union—report the lowest rates of reusing and using less resources.

Students report trying to learn about the environment and discuss caring for it most often in Balkan education systems and least often in Scandinavian and Western European education systems including Denmark, Finland and the Netherlands (Fig. 4.6). Students are most likely to participate in group activities and warn their friends about environmental mistakes in Albania, Bosnia and Herzegovina, Kosovo, the Republic of North Macedonia, and Montenegro with more than half of students

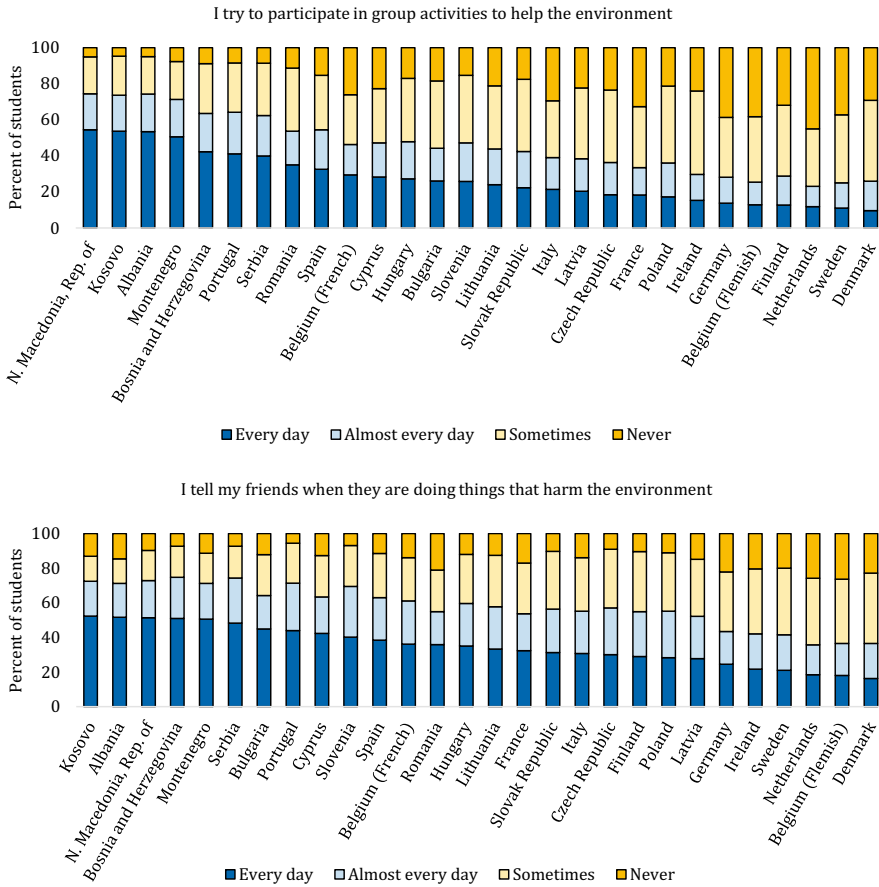


Fig. 4.6 Frequency of student actions: activities in groups and warning friends

engaging in these behaviors every day and an additional 20% almost every day. In contrast, education systems like Belgium (Flemish), Denmark, Finland, the Netherlands, and Sweden report that less than a third of students participate in these activities every day or almost every day (Fig. 4.6).

4.4 Discussion

This study of intended, implemented, and attained curriculum in the area of environmental knowledge aimed to address four key research questions.

The findings provide an affirmative answer to the first research question—whether national curricula, teaching practices, and student outcomes related to education for environmental sustainability vary across European education systems. A review of summaries of national curricula presented in the TIMSS 2023 encyclopedia reveals that the extent and structure of environmental topics included in national curricular documents and intended to be taught vary across education systems.

In general, the study of intended curricula reveals that European education systems do not uniformly cover essential aspects of environmental sustainability. Topics related to living nature are better covered than physical sciences. For example, the sustainable use of energy and climate change are not taught in a third to more than half of the education systems. However, the positive and negative impacts of humans on the environment are taught across all of Europe in every observed education system in this study.

There are differences in the contents requested to be taught by grade four and approaches to teaching environmental sustainability. Some education systems focused their curriculum on developing positive attitudes, values and behaviors toward environmental issues (Belgium, Finland, Ireland, Poland), while others outline specific contents to be taught (Italy, Latvia, the Slovak Republic). In France, teachers are requested to identify issues related to environment when teaching basic science concepts. In some systems, focus is given to use of resources and protecting the environment (Germany), while others primarily support fostering investigative attitudes toward nature and teaching environmentally responsible behaviors (the Czech Republic, the Netherlands, Portugal) or developing responsibility for environmental sustainability (Romania). Several education systems also explicitly require students to develop an understanding of human interaction with nature (Bulgaria, Denmark, Montenegro, Portugal, Sweden) with a particular focus on pollution, recycling and waste management to preserve nature (Serbia, Slovenia). Spain, by contrast, emphasizes teaching general interactions between living things.

Education systems with the highest mean achievement differ from others in that their curricula explicitly encourage student engagement or practice participation in activities of caring for the environment on local levels. However, the available curricular descriptions are general and are open to interpretation regarding how content is taught in schools. It is likely that these curricula are supported by additional teaching materials and instructions which were not observed in this study.

One of the aims of this study was to identify exemplary practices across Europe. Finland, Ireland, and Poland stand out as education systems with clearly defined and explicit environmental education goals within their curricula. For example, Finland's curriculum states:

Building a Sustainable Future: Students study biodiversity, climate change, and its mitigation; sustainable use of natural resources; promoting health; caring for one's own

cultural heritage; living in a multicultural world; and the global wellbeing of humanity now and in the future. Students take part in a collaborative project in which they practice participation and involvement at the local or global level.

Poland and Ireland directly request teaching of environmental awareness and to develop values. Poland emphasizes:

... learning the values and interrelationships of components of the natural environment, learning the values and norms that source a healthy ecosystem, and developing behaviours resulting from these values.

Ireland specifies in the main content of the *Environmental Awareness* unit:

...identify positive aspects of natural and built environments; identify the interrelationship of living and nonliving elements of local and other environments; become aware of the importance of Earth's renewable and non-renewable resources; recognize how people's actions affect their environment; come to appreciate the need to conserve resources; ... identify some ways in which science and technology contribute positively to society; recognize and investigate human activities that have positive and negative effects on local and wider environments ... caring for the Environment, examine a number of ways in which the local environment could be improved or enhanced; identify and discuss a local, national, or global environmental issue; realize that there is a personal and community responsibility for taking care of the environment.

Ireland's curriculum statements go beyond the list of observed topics in this study, emphasizing activities and higher-order cognitive skills encouraging students to appreciate, investigate, problem-solve, discuss, and take responsibility for environmental care. The structure aligns with key competencies such as critical thinking, community participation, and interdisciplinary connections—competencies widely recognized as essential for educators to address sustainability challenges (Corres et al., 2020).

Given their explicit curricular emphasis and high student achievement, these education systems provide positive examples of intended curricula for teaching environmental sustainability.

Variations in how environmental sustainability content is taught across education systems is also evident in their reports on topics assessed in TIMSS. While most education systems confirmed that these topics are taught to all students—consistent with the TIMSS aim of assessing knowledge acquired in school—some systems did not cover certain topics. Two topics were omitted in the majority of education systems: fossils and competition in ecosystems, which are most likely addressed in higher grades than grade four. Moreover, the issue of Earth's rising average temperatures and climate change was reported as not intended to be taught to any students in more than half of the 28 education systems and in 4 systems was reserved for advanced students, despite many systems acknowledging environmental issues in their curricula.

Overall, the analysis of inclusion of specific topics across curricula reveals that, when asked about the teaching of specific topics, education systems report a higher degree of intended coverage than might be inferred from the general curriculum

documents. This finding underscores the need for further investigation into the curricular foundations of student knowledge.

A review of the linkage between Sustainable Development Goals and education outcomes (Kioupi & Voulvoulis, 2019) found that the most relevant pedagogies for fostering sustainability competencies engage the cognitive (head), psychomotor (hands), and affective (heart) domains. While all three domains are present across the observed education systems, all three are not present in each. Effective strategies include problem-based learning, active learning, community service learning, critical emancipatory pedagogy, place-based environmental education, ecojustice education, community learning, and traditional ecological knowledge. However, evidence from TIMSS show that many of these elements are already integrated into European curricula.

The examination of implemented curricula and the relationship with intended curricula topics, topics taught by teachers, and student achievement provides positive findings. The answer to the second research question—how knowledge is linked to content taught in schools—is not straightforward. On average, the achievement of students who had not yet been taught specific content was not lower than the achievement of students who had been taught the topics before taking the assessment. This suggests that students also acquire knowledge about environmental topics outside the classroom. Only in some education systems, and only for some topics, was the achievement of students who had not been taught the content lower than the achievement of students who had already been introduced to these concepts.

A positive finding of the analysis is that teachers across the European education systems reported teaching more topics than were explicitly outlined in curricular documents. There are only a few cases of education systems where notable percentages of students were reported not to have been taught some contents which are part of the prescribed curricula. It should also be noted that TIMSS assessments were administered several months before the end of school year, leaving teachers time to teach some concepts after reporting them as not yet taught.

The findings underscore the importance of involvement of teachers in teaching the content they believe students need to be taught. While it is important that teachers are well-informed about the content they are expected to teach, they also need support and autonomy to quickly adapt their instruction to meet students' growing learnings needs, including areas beyond the scope of the national curriculum.

Across Europe, there are significant differences in implemented teaching content. In some education systems, the curriculum is demanding, yet item coverage reported after assessments is low (for example, in Belgium [Flemish]). A comparative study of curricula from four Eastern European education systems—the Czech Republic, Estonia, Poland, and Slovenia—highlighted substantial differences in the breadth of learning outcomes and topics (Káčovský et al., 2021). For example, Slovenia's highly detailed curriculum contains six times as many learning outcomes as the

much briefer Czech curriculum for the same science subjects; however, higher-order cognitive goals remain largely absent from Slovenia's curriculum compared to other examined curricula.

The main findings regarding attained curricula indicate differences in student achievement in environmental knowledge that do not reveal systematic patterns according to geographic or other characteristics of the observed education systems.

Within attained curricula, students' attitudes toward nature are also considered, as these are assumed to develop alongside learning about environmental topics. Findings about the relationship between environmental awareness and achievement highlight the importance of teaching environmental content. The weak or nonexistent correlations between students' agreement with statements about enjoying nature and their achievement suggest that students appreciate nature regardless of their knowledge or learning opportunities. A more systematic pattern emerges in students' agreement with the statement, "Addressing climate change should be a high priority." While the relationship between this belief and achievement remains weak, it is consistently observed in most education systems. Unlike other statements related to enjoying nature, this one requires students to understand the concept of climate change and the meaning of priority—both of which must be explicitly taught and can explain stronger links to achievement than agreements with other statements. The strongest relationship is found in Belgium (Flemish), Denmark, Finland, and Italy. In Finland, climate change is part of the curriculum and in the other three education systems the curriculum requires the development of students' understanding of environmental problems and of the interaction between humans and nature. This suggests that higher levels of environmental knowledge may strengthen the link between attitudes and knowledge, particularly when some conceptual understanding is needed to form an opinion about the issue.

Furthermore, the Students Value Environmental Preservation scale, based on students' agreement with environmental statements, was found to predict higher environmental knowledge in all education systems except four. The strongest associations were observed in Albania, Bulgaria, and the Slovak Republic—systems that differ substantially in their mean achievement levels but are all located in Eastern Europe. In general, the development of positive attitudes toward nature appears to play an important role in enhancing students' knowledge.

Unexpected patterns emerge in student reports of their actual engagement in environmental activities requiring some knowledge. The highest percentages of students—over 70%—who actively try to save resources, learn about the environment, and participate in environmental activities daily or almost daily are found in Balkan and Eastern European education systems, including some that are not European Union members. These systems may be particularly active in environmental initiatives as part of their efforts to join the European Union, frequently participating in large-scale projects with other European nations. For example, a study comparing four European education systems (Kováč et al., 2021) found that in Serbia, many

schools take part in the Eco-Schools program, a global initiative involving 56,000 schools. Additionally, many Eastern European and Balkan schools engage in green projects run by nongovernmental organizations or under the Erasmus program such as the Education for Climate Community.³

In contrast, Scandinavian education systems report significantly lower student participation in environmental activities, with fewer than a third of students engaging in them daily or almost daily. While the present study does not provide explanations for the lower involvement of younger students in Scandinavian education systems, it highlights the need for further research.

Finally, regarding the growing trend of gender differences in science achievement and attitudes in TIMSS, the majority of results across the education systems in this study did not differ by gender. This finding aligns with previous research, such as the study by Liefländer and Bogner (2014), which examined gender and age differences in environmental awareness. Their study concluded that environmental education is more effective in fostering pro-environmental attitudes in younger students (aged 9–10) than in older students, and that gender does not necessarily influence the development of such attitudes.

4.5 Limitations of the Study

This study aimed to address gaps in research regarding the relationships between teaching, knowledge, and the development of attitudes toward environmental awareness, particularly among young children and through cross-national comparisons of education systems. While the study utilized multiple sources of data, each source has inherent limitations, particularly when combined. One limitation is that the TIMSS study does not provide data for all European Union member education systems or for all non-European Union education systems. The findings of this study are limited to the education systems participating in TIMSS with their grade four student populations. The primary source, the curricula summaries in the TIMSS 2023 encyclopedia (Reynolds et al., 2024), are not in a comparable form. The curricular documents have been, for most systems, summarized into general overviews, which can lead to an underestimation of prescribed content. Some systems may include more environmental topics in teaching through national policies, such as school rules for saving resources or separating waste. Then, some teachers may underreport the teaching of a topic if they have not completed it. Future studies with a specific focus on environmental contents are needed to reveal the full extent of differences across Europe. Finally, the indices and sets of questions on sustainability used in this study were developed a few years before the data collection in 2023. As environmental

³ Accessible at: <https://education-for-climate.ec.europa.eu/community/>

sustainability is a rapidly evolving issue, the relevance of some concepts may have shifted. To accurately capture the current situation in Europe, future studies should develop new or adapted questions, statements, and variables to capture emerging issues.

Unexpected findings also emerged regarding student behaviors, such as students reusing materials. Interestingly, some economically strong education systems exhibited lower rates of reuse among students. While economic factors may partially explain this, the available data do not allow for a detailed analysis or overview of the extent of recycling across the education systems, highlighting the need for future research to more comprehensively address the issue.

4.6 Conclusion

The TIMSS data on education for environmental sustainability, which includes information on environmental knowledge, attitudes, student activities, and content taught, provides a valuable, though complex, source for comparing education systems across three levels of curricula—intended, implemented, and attained—revealing important insights.

In summary, national curricula, teaching approaches, and student outcomes in education for environmental sustainability vary across European education systems. The national curricula show large differences in the presentation and scope of content intended to be taught, including topics and expected learning outcomes, ranging from direct content knowledge of environmental issues to engagement of students in activities and practical actions to care for nature. Teachers report different levels of coverage of the topics from their national curricular documents; in general, they frequently teach more than is indicated in official curricula. Student outcomes vary across Europe, although these differences do not follow clear geographic patterns.

The comparison of national curricula and mean achievement reveals that education systems emphasizing understanding of environmental issues and student engagement in practical activities at the local level, tend to show higher student knowledge. An unexpected finding is that students who had not yet been taught specific content demonstrated knowledge levels comparable to students who had been taught these in science classes. This indicates that environmental concepts are also learned outside science classes—reporting of content taught in science may not fully capture learning that occurs elsewhere, even in school.

Another unexpected result was that higher student knowledge is generally not directly linked to basic positive attitudes like enjoyment of nature; low achieving students also expressed enjoyment of nature and care for living beings. Higher achievement is, however, linked to general environmental awareness, complex attitudinal scales, and attitudes towards issues that require understanding and

knowledge, such as climate change. Therefore, the answer to the third research question—whether higher student environmental knowledge is linked to more positive attitudes toward environmental sustainability—is affirmative: more positive complex attitudes and opinions about specific issues are linked to higher knowledge in a large number of education systems.

In relation to the fourth and final research question—addressing whether groups of European education systems share similarities in teaching approaches, student knowledge, or attitudes toward environmental sustainability—no clear geographical pattern in environmental knowledge and national curricula was identified. However, greater student engagement in environmental activities was observed in the eastern part of Europe than in the western part.

The teaching of environmental content across Europe varies; however, some education systems may serve as models for others in developing their goals and curricular documents, with respect to particular aspects of environmental education. Some show strengths in national curricular documents, others in engagement of students in environmental activities. The findings suggest that more frequent teaching and learning activities lead to greater knowledge, stronger connections between attitudes, and better preparedness among young students for environmental preservation activities. However, certain content areas—such as green energy, renewable resources, and climate change, which are widely discussed in public media—are still not systematically included in the curriculum of most education systems. The available sources also lacked data which would allow for greater understanding of the existing reports about intended curricula and, in particular, the rationale for including specific content, practical activities implemented in schools, and the responsibilities of teachers and schools to provide and engage students in activities outside schools. More precise national descriptions would support future research on the inclusion of students in environmental actions.

Appendix (Tables 4.11, 4.12, 4.13, 4.14, 4.15, 4.16, 4.17, and 4.18)

Table 4.11 Coverage of items by curricula in each education system

| | ITA | MKD | ROM | LTU | SWE | BIH | DNK | DEU | PRT | SRB | IRL | MNE | CZE | FRA | ESP | ALB | LVA | NLD | BFR | FIN | SVK | HUN | XKX | SVN | POL | BFL | Total |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| SE71069 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 23 |
| SE71080 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 21 |
| SE71220 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| SE61015 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 26 |
| SE61124 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| SE61116 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| SE81083 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 22 |
| SE81073 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 23 |
| SE81054 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 |
| SE81036 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81075 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 |
| SE81920A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81920B | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81204 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 |
| SE81070 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| SE81055 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81207A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 18 |
| SE81207B | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 18 |
| SE71063 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 |
| SE71214 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE71213 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 17 |
| SE81044 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81042 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 18 |

(continued)

Table 4.11 (continued)

| | ITA | MKD | ROM | LTU | SWE | BIH | DNK | DEU | PRT | SRB | IRL | MNE | CZE | FRA | ESP | ALB | LVA | NLD | BFR | FIN | SVK | HUN | XKX | SVN | POL | BFL | Total |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| SE81202 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81239 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| SE71076 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 23 |
| SE71223 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 25 |
| SE81080 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 |
| SE81168 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 26 |
| SE81085 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81238 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 |
| SE81200 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 21 |
| SE81079 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 22 |
| SE81076 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE81077 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 26 |
| SE81212 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| SE61069 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 22 |
| SE61019 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE71071 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 24 |
| SE71222 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| SE71065 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 22 |
| SE71081 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| SE71201 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 23 |
| SE71237 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 20 |

Note: 1, the item is covered by the education system; ALB, Albania; BFL, Belgium (Flemish); BFR, Belgium (French); BIH, Bosnia & Herzegovina; CZE, Czech Republic; DEU, Germany; DNK, Denmark; ESP, Spain; FIN, Finland; FRA, France; HUN, Hungary; IRL, Ireland; ITA, Italy; LTU, Lithuania; LVA, Latvia; MKD, North Macedonia; MNE, Montenegro; NLD, Netherlands; POL, Poland; PRT, Portugal; ROM, Romania; SRB, Serbia; SVK, Slovak Republic; SVN, Slovenia; SWE, Sweden; XKX, Kosovo

Table 4.12 Differences in achievement in environmental knowledge between students participating or not in environmental teaching activities by teachers: visiting natural areas

| Education system | Take students to visit natural areas (e.g., a pond or meadow) | | | | | | |
|------------------------|---|--------|--------|--------|-------------------|---------|------|
| | Yes (% of students) | SE | Mean | SE | Diff. (yes/no) | SE | Sig. |
| Finland | 97.30 | (0.97) | 543.17 | (3.35) | 11.08 | (12.54) | |
| Albania | 95.13 | (1.73) | 478.29 | (6.41) | 13.67 | (18.77) | |
| Lithuania | 91.66 | (2.36) | 519.73 | (3.55) | 8.93 | (12.04) | |
| Bosnia and Herzegovina | 90.68 | (2.36) | 447.18 | (5.21) | 15.88 | (10.58) | |
| Latvia | 90.18 | (1.98) | 503.63 | (3.65) | 1.53 | (8.74) | |
| Slovak Republic | 87.32 | (2.44) | 506.89 | (4.64) | 15.88 | (7.44) | * |
| Romania | 86.97 | (3.04) | 522.34 | (6.39) | 23.49 | (16.28) | |
| Slovenia | 86.97 | (2.52) | 519.43 | (3.13) | 4.47 | (4.60) | |
| Belgium (Flemish) | 86.61 | (3.05) | 490.61 | (3.64) | 7.23 | (7.15) | |
| Montenegro | 86.34 | (2.30) | 465.05 | (2.73) | 3.95 | (6.66) | |
| N. Macedonia, Rep. of | 84.17 | (2.88) | 437.38 | (6.03) | 3.93 | (14.24) | |
| Czech Republic | 82.30 | (2.72) | 520.20 | (3.48) | 1.29 | (7.66) | |
| Serbia | 81.70 | (3.04) | 517.74 | (3.55) | 3.59 | (8.21) | |
| Germany | 81.14 | (2.76) | 516.69 | (3.31) | 20.35 | (10.12) | * |
| Denmark | 80.45 | (3.50) | 534.61 | (4.02) | 4.40 | (7.73) | |
| Kosovo | 76.83 | (3.67) | 400.48 | (5.05) | 8.83 | (9.32) | |
| Spain | 75.78 | (2.13) | 510.54 | (2.88) | 1.79 | (5.69) | |
| Poland | 75.17 | (3.38) | 556.68 | (2.54) | 1.16 | (5.66) | |
| Bulgaria | 73.20 | (3.09) | 526.74 | (7.50) | 21.74 | (12.29) | |
| Hungary | 71.13 | (4.06) | 536.57 | (5.13) | 12.37 | (10.95) | |
| Sweden | 70.54 | (3.75) | 528.71 | (4.96) | 3.74 | (7.58) | |
| Italy | 67.87 | (3.06) | 519.68 | (3.39) | 7.21 | (5.44) | |
| Cyprus | 63.27 | (3.41) | 481.29 | (3.99) | 5.02 | (6.23) | |
| Portugal | 60.13 | (3.14) | 520.06 | (4.23) | 4.08 | (5.52) | |
| Belgium (French) | 57.46 | (3.41) | 485.03 | (4.25) | 5.70 | (6.43) | |
| France | 46.48 | (4.47) | 498.43 | (6.02) | 5.09 | (7.00) | |
| Ireland | 46.46 | (4.25) | 540.01 | (5.19) | 6.92 | (6.78) | |
| Netherlands | 39.46 | (5.32) | 525.40 | (4.50) | 10.71 | (5.74) | |

Note: SE, standard error

*Significant difference between the mean scale scores at the time of teaching

Table 4.13 Differences in achievement in environmental knowledge between students participating or not in environmental teaching activities by teachers: participating in environmentally responsible activities

| Education system | Have students participate in environmentally responsible activities (e.g., pick up trash) | | | | | | |
|------------------------|---|--------|--------|--------|----------------|---------|------|
| | Yes (% of students) | SE | Mean | SE | Diff. (yes/no) | SE | Sig. |
| Bulgaria | 98.94 | (0.78) | 531.93 | (6.01) | 60.61 | (11.88) | * |
| Romania | 98.74 | (1.25) | 525.06 | (6.04) | – | – | |
| Kosovo | 98.67 | (0.98) | 402.97 | (4.07) | 48.38 | (65.76) | |
| Slovak Republic | 97.73 | (0.94) | 508.22 | (4.47) | 29.93 | (15.59) | |
| Hungary | 97.54 | (1.08) | 533.41 | (4.32) | 16.74 | (26.13) | |
| Albania | 96.07 | (2.88) | 478.63 | (6.38) | 8.26 | (16.03) | |
| Montenegro | 94.09 | (0.94) | 467.08 | (2.81) | 21.50 | (8.30) | * |
| Bosnia and Herzegovina | 93.65 | (2.61) | 446.26 | (5.28) | 37.85 | (9.33) | * |
| Lithuania | 92.91 | (1.70) | 519.81 | (3.27) | 8.50 | (13.78) | |
| Serbia | 92.87 | (1.83) | 518.67 | (3.38) | 22.27 | (13.22) | |
| Slovenia | 92.32 | (1.72) | 519.54 | (3.07) | 7.29 | (6.11) | |
| N. Macedonia, Rep. of | 90.40 | (2.62) | 438.54 | (5.56) | 18.63 | (22.39) | |
| Finland | 86.74 | (2.10) | 543.13 | (3.35) | 1.94 | (5.97) | |
| Belgium (Flemish) | 85.47 | (3.18) | 492.44 | (3.88) | 5.98 | (12.44) | |
| Belgium (French) | 83.32 | (2.42) | 483.48 | (3.40) | 4.63 | (9.63) | |
| Poland | 83.08 | (2.76) | 555.45 | (2.69) | 8.95 | (6.29) | |
| Latvia | 81.70 | (3.39) | 504.45 | (3.89) | 2.45 | (7.46) | |
| Czech Republic | 81.63 | (2.76) | 520.25 | (3.64) | 1.95 | (6.00) | |
| Italy | 81.13 | (2.60) | 517.47 | (2.93) | 0.56 | (6.75) | |
| Portugal | 80.78 | (2.63) | 517.83 | (3.54) | 3.16 | (6.71) | |
| Spain | 79.91 | (2.26) | 507.77 | (2.91) | 11.63 | (5.20) | * |
| Denmark | 79.74 | (3.38) | 539.34 | (3.94) | 19.21 | (6.26) | * |
| Germany | 78.59 | (2.84) | 514.79 | (3.63) | 9.08 | (8.79) | |
| Ireland | 76.37 | (3.46) | 534.81 | (4.27) | 6.31 | (8.66) | |
| France | 74.44 | (3.05) | 495.21 | (4.77) | 2.26 | (8.22) | |
| Cyprus | 72.27 | (3.04) | 480.27 | (3.68) | 2.99 | (7.46) | |
| Sweden | 71.58 | (3.65) | 527.59 | (5.01) | 0.04 | (6.82) | |
| Netherlands | 61.07 | (5.25) | 520.00 | (4.39) | 2.80 | (7.27) | |

Note: SE, standard error; –, result not reported because estimation is not reliable

*Significant difference between the mean scale scores at the time of teaching

Table 4.14 Differences in achievement in environmental knowledge between students participating or not in environmental teaching activities by teachers: doing research or projects

| Education system | Have students do research or projects on a particular environmental topic (e.g., pollution, climate change) | | | | | | |
|------------------------|---|--------|--------|--------|----------------|---------|------|
| | Yes (% of students) | SE | Mean | SE | Diff. (yes/no) | SE | Sig. |
| Romania | 96.94 | (1.59) | 525.68 | (6.05) | 9.21 | (7.71) | |
| Albania | 94.94 | (2.69) | 480.46 | (6.47) | 29.81 | (16.06) | |
| N. Macedonia, Rep. of | 92.15 | (2.15) | 437.81 | (5.71) | 13.39 | (23.64) | |
| Portugal | 92.10 | (1.93) | 518.74 | (3.66) | 3.85 | (13.92) | |
| Kosovo | 91.43 | (2.61) | 404.71 | (4.26) | 27.63 | (12.40) | * |
| Serbia | 89.59 | (2.26) | 517.17 | (3.33) | 0.86 | (10.71) | |
| Bulgaria | 86.92 | (2.42) | 544.89 | (5.75) | 94.23 | (23.70) | * |
| Italy | 83.96 | (2.47) | 517.20 | (2.89) | 2.71 | (7.63) | |
| Spain | 76.37 | (2.40) | 509.75 | (3.17) | 0.73 | (5.11) | |
| Bosnia and Herzegovina | 74.48 | (4.04) | 449.15 | (6.17) | 1.90 | (8.91) | |
| Ireland | 73.49 | (3.13) | 537.45 | (4.42) | 4.31 | (5.80) | |
| Slovak Republic | 72.50 | (2.92) | 508.58 | (5.41) | 1.18 | (8.77) | |
| Montenegro | 72.36 | (2.41) | 466.98 | (2.98) | 4.46 | (6.87) | |
| Lithuania | 67.10 | (3.71) | 518.59 | (3.99) | 5.72 | (6.20) | |
| Germany | 64.42 | (3.49) | 517.59 | (4.11) | 13.27 | (6.85) | |
| Sweden | 62.99 | (4.42) | 527.06 | (5.43) | 1.47 | (7.73) | |
| Denmark | 61.34 | (4.34) | 539.79 | (3.76) | 11.15 | (5.16) | * |
| Slovenia | 61.34 | (3.22) | 519.31 | (3.70) | 1.82 | (4.27) | |
| Finland | 57.33 | (3.20) | 545.43 | (4.11) | 5.98 | (5.10) | |
| Poland | 57.11 | (3.38) | 557.11 | (3.66) | 0.33 | (4.41) | |
| Cyprus | 54.29 | (3.90) | 481.03 | (4.24) | 3.47 | (6.21) | |
| Latvia | 54.16 | (3.88) | 504.61 | (4.97) | 1.81 | (6.47) | |
| Hungary | 50.63 | (3.98) | 542.99 | (6.06) | 20.23 | (8.95) | * |
| France | 44.49 | (4.27) | 500.66 | (5.56) | 9.47 | (6.95) | |
| Belgium (Flemish) | 43.85 | (3.83) | 496.27 | (5.57) | 8.37 | (5.95) | |
| Czech Republic | 42.52 | (3.04) | 526.84 | (4.56) | 11.95 | (4.33) | * |
| Belgium (French) | 39.10 | (3.47) | 480.57 | (5.71) | 3.78 | (7.15) | |
| Netherlands | 37.90 | (4.65) | 523.67 | (5.29) | 7.67 | (6.36) | |

Note: SE, standard error

*Significant difference between the mean scale scores at the time of teaching

Table 4.15 Differences in achievement in environmental knowledge between students participating or not in environmental teaching activities by teachers: participating in programs outside of school

| Education system | Provide opportunities for students to participate in outdoor environmental education programs outside of school | | | | | | Sig. |
|------------------------|---|--------|--------|--------|-------------------|---------|------|
| | Yes (% of students) | SE | Mean | SE | Diff. (yes/no) | SE | |
| Romania | 9.70 | (2.36) | 523.49 | (6.27) | 36.08 | (12.92) | * |
| Bulgaria | 78.22 | (3.39) | 540.43 | (6.47) | 31.62 | (23.73) | |
| Albania | 76.45 | (5.35) | 488.90 | (6.64) | 42.26 | (18.45) | * |
| N. Macedonia, Rep. of | 74.87 | (3.28) | 429.45 | (6.03) | 29.09 | (12.45) | * |
| Slovak Republic | 72.23 | (3.24) | 507.78 | (5.08) | 4.04 | (7.15) | |
| Kosovo | 69.53 | (4.00) | 400.57 | (5.21) | 5.69 | (8.66) | |
| Poland | 69.38 | (3.80) | 556.07 | (2.77) | 2.93 | (5.62) | |
| Lithuania | 69.27 | (3.47) | 519.72 | (3.85) | 2.44 | (6.97) | |
| Montenegro | 67.86 | (2.15) | 468.35 | (3.05) | 8.59 | (5.30) | |
| Bosnia and Herzegovina | 63.37 | (5.62) | 455.14 | (5.24) | 17.68 | (8.92) | |
| Serbia | 62.94 | (3.55) | 516.79 | (3.98) | 0.79 | (6.29) | |
| Czech Republic | 60.83 | (3.25) | 521.39 | (3.99) | 3.63 | (4.49) | |
| Italy | 60.41 | (3.27) | 517.70 | (2.95) | 0.86 | (5.67) | |
| Denmark | 59.35 | (4.30) | 537.71 | (4.28) | 5.50 | (5.70) | |
| Cyprus | 56.41 | (3.48) | 476.36 | (4.42) | 7.07 | (7.01) | |
| Hungary | 55.28 | (4.40) | 539.02 | (5.54) | 13.46 | (9.52) | |
| Portugal | 54.11 | (3.37) | 519.10 | (3.79) | 1.45 | (5.34) | |
| Spain | 51.71 | (2.70) | 508.77 | (3.56) | 2.50 | (4.57) | |
| Slovenia | 51.01 | (3.58) | 519.31 | (4.06) | 1.45 | (3.93) | |
| Latvia | 47.63 | (4.29) | 505.24 | (5.18) | 2.80 | (6.78) | |
| Sweden | 41.16 | (4.44) | 529.58 | (4.87) | 3.36 | (7.48) | |
| Belgium (French) | 36.06 | (3.52) | 485.24 | (5.21) | 4.13 | (6.75) | |
| Germany | 28.20 | (3.59) | 526.26 | (6.17) | 18.65 | (7.53) | * |
| Finland | 27.30 | (2.62) | 539.34 | (5.20) | 4.86 | (5.18) | |
| France | 27.13 | (3.58) | 500.82 | (6.04) | 7.02 | (6.92) | |
| Ireland | 24.23 | (2.84) | 544.82 | (7.60) | 11.24 | (8.09) | |
| Belgium (Flemish) | 22.60 | (3.36) | 488.35 | (7.97) | 4.17 | (8.13) | |
| Netherlands | 19.91 | (4.09) | 509.56 | (8.12) | 11.67 | (9.20) | |

Note: SE, standard error

*Significant difference between the mean scale scores at the time of teaching

Table 4.16 Percentage of students being taught two life science topics by their teachers

| Education system | | Relation- ships in simple food chains | Common sources of energy | Education system | | Relation- ships in simple food chains | Common sources of energy |
|---------------------------|--------------|---|--------------------------------|--------------------------|--------------|---|--------------------------------|
| | | % | % | | | % | % |
| Albania | Before | 23.5 (4.7) | 24.7 (4.5) | Kosovo | Before | 74.5 (2.9) | 32.4 (3.2) |
| | This year | 48.4 (5.8) | 45.1 (5.5) | | This year | 23.9 (2.9) | 65.0 (3.3) |
| | Not yet | 28.1 (4.8) | 30.2 (5.5) | | Not yet | 1.7 (0.8) | 2.6 (0.8) |
| Belgium (Flemish) | Before | 49.3 (5.5) | 12.0 (3.2) | Latvia | Before | 27.2 (2.4) | 6.8 (1.4) |
| | This year | 29.2 (4.7) | 55.5 (4.7) | | This year | 64.1 (2.4) | 81.0 (2.4) |
| | Not yet | 21.5 (4.0) | 32.4 (4.3) | | Not yet | 8.7 (1.5) | 12.2 (2.0) |
| Belgium (French) | Before | 69.1 (3.1) | 17.2 (2.7) | Lithuania | Before | 12.7 (3.9) | 12.3 (3.3) |
| | This year | 30.4 (3.1) | 81.4 (2.8) | | This year | 52.6 (5.8) | 66.0 (5.9) |
| | Not yet | 0.5 (0.5) | 1.4 (0.7) | | Not yet | 34.8 (5.6) | 21.6 (4.8) |
| Bosnia and Herzegovina | Before | 68.3 (3.1) | 11.5 (2.1) | Montenegro | Before | 6.6 (1.7) | 3.0 (1.2) |
| | This year | 26.4 (3.3) | 66.2 (3.2) | | This year | 85.5 (2.6) | 21.2 (2.9) |
| | Not yet | 5.4 (1.8) | 22.3 (2.7) | | Not yet | 7.9 (2.2) | 75.8 (2.9) |
| Bulgaria | Before | 29.5 (2.7) | 9.2 (1.9) | Netherlands | Before | 82.9 (2.4) | 29.4 (2.8) |
| | This year | 56.8 (3.1) | 69.4 (3.2) | | This year | 13.6 (2.3) | 57.4 (3.2) |
| | Not yet | 13.7 (2.3) | 21.4 (2.8) | | Not yet | 3.5 (1.0) | 13.2 (2.3) |
| Cyprus | Before | 33.1 (3.8) | 14.2 (2.6) | N. Macedonia, Rep. of | Before | 26.2 (4.2) | 42.1 (5.3) |
| | This year | 47.2 (4.8) | 55.3 (4.2) | | This year | 62.7 (5.0) | 55.0 (5.6) |
| | Not yet | 19.7 (3.7) | 30.4 (4.2) | | Not yet | 11.1 (4.1) | 2.9 (1.9) |
| Czech Republic | Before | 44.1 (2.9) | 15.7 (2.4) | Poland | Before | 86.1 (2.4) | 43.0 (4.0) |
| | This year | 46.3 (3.0) | 52.0 (3.5) | | This year | 13.5 (2.4) | 55.4 (3.9) |
| | Not yet | 9.5 (1.6) | 32.3 (3.3) | | Not yet | 0.4 (0.4) | 1.6 (0.7) |

(continued)

Table 4.16 (continued)

| Education system | | Relation- ships in simple food chains | Common sources of energy | Education system | | Relation- ships in simple food chains | Common sources of energy |
|------------------|-----------|---|--------------------------------|---------------------|-----------|---|--------------------------------|
| | | % | % | | | % | % |
| Denmark | Before | 47.0 (4.0) | 8.5 (1.9) | Portugal | Before | 18.8 (2.4) | 36.6 (3.0) |
| | This year | 30.2 (3.7) | 62.3 (4.0) | | This year | 57.1 (3.4) | 36.1 (3.0) |
| | Not yet | 22.8 (3.5) | 29.2 (3.6) | | Not yet | 24.1 (3.3) | 27.3 (3.2) |
| Finland | Before | 47.7 (3.7) | 29.0 (3.3) | Romania | Before | 27.9 (3.2) | 7.9 (2.1) |
| | This year | 24.9 (3.2) | 45.6 (3.7) | | This year | 24.5 (2.8) | 78.3 (2.9) |
| | Not yet | 27.4 (3.5) | 25.3 (3.0) | | Not yet | 47.6 (3.4) | 13.8 (2.3) |
| France | Before | 68.5 (3.6) | 20.1 (3.1) | Serbia | Before | 33.1 (3.0) | 24.5 (2.4) |
| | This year | 17.8 (2.7) | 64.3 (4.0) | | This year | 42.0 (2.7) | 52.6 (3.2) |
| | Not yet | 13.7 (2.8) | 15.5 (3.2) | | Not yet | 24.9 (2.3) | 22.9 (2.4) |
| Germany | Before | 36.0 (4.0) | 22.9 (3.2) | Slovak Republic | Before | 15.6 (3.3) | 3.9 (1.6) |
| | This year | 36.7 (3.8) | 69.5 (3.4) | | This year | 68.8 (3.9) | 49.9 (4.1) |
| | Not yet | 27.3 (3.0) | 7.6 (1.5) | | Not yet | 15.6 (3.1) | 46.2 (4.0) |
| Hungary | Before | 32.0 (3.3) | 13.9 (2.3) | Slovenia | Before | 25.4 (3.8) | 21.4 (3.0) |
| | This year | 39.5 (3.0) | 39.6 (3.6) | | This year | 55.9 (4.5) | 72.5 (3.2) |
| | Not yet | 28.4 (3.2) | 46.5 (3.7) | | Not yet | 18.7 (3.1) | 6.2 (1.7) |
| Ireland | Before | 33.9 (4.5) | 16.9 (3.1) | Spain | Before | 21.1 (3.3) | 11.2 (2.2) |
| | This year | 43.8 (4.2) | 79.9 (3.5) | | This year | 41.0 (3.8) | 49.5 (4.4) |
| | Not yet | 22.3 (3.4) | 3.2 (2.0) | | Not yet | 37.9 (3.2) | 39.4 (3.8) |
| Italy | Before | 44.4 (3.9) | 35.0 (4.1) | Sweden | Before | 23.7 (3.0) | 7.9 (1.8) |
| | This year | 27.2 (3.2) | 23.9 (3.3) | | This year | 43.0 (3.3) | 24.0 (2.8) |
| | Not yet | 28.4 (3.7) | 41.0 (3.9) | | Not yet | 33.3 (3.2) | 68.1 (3.2) |

Note: Standard errors appear in parentheses

Table 4.16 (continued)

| Education system | | Relation-ships in simple food chains | | Common sources of energy | | | Relation-ships in simple food chains | | Common sources of energy | |
|------------------------|-----------|--------------------------------------|-------|--------------------------|-------|-----------|--------------------------------------|-------|--------------------------|-------|
| | | % | SE | % | SE | | % | SE | % | SE |
| Albania | Before | 23.5 | (4.7) | 24.7 | (4.5) | Before | 74.5 | (2.9) | 32.4 | (3.2) |
| | This year | 48.4 | (5.8) | 45.1 | (5.5) | This year | 23.9 | (2.9) | 65.0 | (3.3) |
| | Not yet | 28.1 | (4.8) | 30.2 | (5.5) | Not yet | 1.7 | (0.8) | 2.6 | (0.8) |
| Belgium (Flemish) | Before | 49.3 | (5.5) | 12.0 | (3.2) | Before | 27.2 | (2.4) | 6.8 | (1.4) |
| | This year | 29.2 | (4.7) | 55.5 | (4.7) | This year | 64.1 | (2.4) | 81.0 | (2.4) |
| | Not yet | 21.5 | (4.0) | 32.4 | (4.3) | Not yet | 8.7 | (1.5) | 12.2 | (2.0) |
| Belgium (French) | Before | 69.1 | (3.1) | 17.2 | (2.7) | Before | 12.7 | (3.9) | 12.3 | (3.3) |
| | This year | 30.4 | (3.1) | 81.4 | (2.8) | This year | 52.6 | (5.8) | 66.0 | (5.9) |
| | Not yet | 0.5 | (0.5) | 1.4 | (0.7) | Not yet | 34.8 | (5.6) | 21.6 | (4.8) |
| Bosnia and Herzegovina | Before | 68.3 | (3.1) | 11.5 | (2.1) | Before | 6.6 | (1.7) | 3.0 | (1.2) |
| | This year | 26.4 | (3.3) | 66.2 | (3.2) | This year | 85.5 | (2.6) | 21.2 | (2.9) |
| | Not yet | 5.4 | (1.8) | 22.3 | (2.7) | Not yet | 7.9 | (2.2) | 75.8 | (2.9) |
| Bulgaria | Before | 29.5 | (2.7) | 9.2 | (1.9) | Before | 82.9 | (2.4) | 29.4 | (2.8) |
| | This year | 56.8 | (3.1) | 69.4 | (3.2) | This year | 13.6 | (2.3) | 57.4 | (3.2) |
| | Not yet | 13.7 | (2.3) | 21.4 | (2.8) | Not yet | 3.5 | (1.0) | 13.2 | (2.3) |
| Cyprus | Before | 33.1 | (3.8) | 14.2 | (2.6) | Before | 26.2 | (4.2) | 42.1 | (5.3) |
| | This year | 47.2 | (4.8) | 55.3 | (4.2) | This year | 62.7 | (5.0) | 55.0 | (5.6) |
| | Not yet | 19.7 | (3.7) | 30.4 | (4.2) | Not yet | 11.1 | (4.1) | 2.9 | (1.9) |
| Czech Republic | Before | 44.1 | (2.9) | 15.7 | (2.4) | Before | 86.1 | (2.4) | 43.0 | (4.0) |
| | This year | 46.3 | (3.0) | 52.0 | (3.5) | This year | 13.5 | (2.4) | 55.4 | (3.9) |
| | Not yet | 9.5 | (1.6) | 32.3 | (3.3) | Not yet | 0.4 | (0.4) | 1.6 | (0.7) |
| Denmark | Before | 47.0 | (4.0) | 8.5 | (1.9) | Before | 18.8 | (2.4) | 36.6 | (3.0) |
| | This year | 30.2 | (3.7) | 62.3 | (4.0) | This year | 57.1 | (3.4) | 36.1 | (3.0) |
| | Not yet | 22.8 | (3.5) | 29.2 | (3.6) | Not yet | 24.1 | (3.3) | 27.3 | (3.2) |
| Finland | Before | 47.7 | (3.7) | 29.0 | (3.3) | Before | 27.9 | (3.2) | 7.9 | (2.1) |
| | This year | 24.9 | (3.2) | 45.6 | (3.7) | This year | 24.5 | (2.8) | 78.3 | (2.9) |
| | Not yet | 27.4 | (3.5) | 25.3 | (3.0) | Not yet | 47.6 | (3.4) | 13.8 | (2.3) |

(continued)

Table 4.16 (continued)

| Education system | | Relation-ships in simple food chains | | Common sources of energy | | | Relation-ships in simple food chains | | Common sources of energy | |
|------------------|-----------|--------------------------------------|-------|--------------------------|-------|-----------|--------------------------------------|-------|--------------------------|-------|
| | | % | SE | % | SE | | % | SE | % | SE |
| France | Before | 68.5 | (3.6) | 20.1 | (3.1) | Before | 33.1 | (3.0) | 24.5 | (2.4) |
| | This year | 17.8 | (2.7) | 64.3 | (4.0) | This year | 42.0 | (2.7) | 52.6 | (3.2) |
| | Not yet | 13.7 | (2.8) | 15.5 | (3.2) | Not yet | 24.9 | (2.3) | 22.9 | (2.4) |
| Germany | Before | 36.0 | (4.0) | 22.9 | (3.2) | Before | 15.6 | (3.3) | 3.9 | (1.6) |
| | This year | 36.7 | (3.8) | 69.5 | (3.4) | This year | 68.8 | (3.9) | 49.9 | (4.1) |
| | Not yet | 27.3 | (3.0) | 7.6 | (1.5) | Not yet | 15.6 | (3.1) | 46.2 | (4.0) |
| Hungary | Before | 32.0 | (3.3) | 13.9 | (2.3) | Before | 25.4 | (3.8) | 21.4 | (3.0) |
| | This year | 39.5 | (3.0) | 39.6 | (3.6) | This year | 55.9 | (4.5) | 72.5 | (3.2) |
| | Not yet | 28.4 | (3.2) | 46.5 | (3.7) | Not yet | 18.7 | (3.1) | 6.2 | (1.7) |
| Ireland | Before | 33.9 | (4.5) | 16.9 | (3.1) | Before | 21.1 | (3.3) | 11.2 | (2.2) |
| | This year | 43.8 | (4.2) | 79.9 | (3.5) | This year | 41.0 | (3.8) | 49.5 | (4.4) |
| | Not yet | 22.3 | (3.4) | 3.2 | (2.0) | Not yet | 37.9 | (3.2) | 39.4 | (3.8) |
| Italy | Before | 44.4 | (3.9) | 35.0 | (4.1) | Before | 23.7 | (3.0) | 7.9 | (1.8) |
| | This year | 27.2 | (3.2) | 23.9 | (3.3) | This year | 43.0 | (3.3) | 24.0 | (2.8) |
| | Not yet | 28.4 | (3.7) | 41.0 | (3.9) | Not yet | 33.3 | (3.2) | 68.1 | (3.2) |

Table 4.17 Teaching of Earth science topics and students’ environmental mean scale scores

| Education system | | Earth science: Physical characteristics of Earth | | | | | Earth science: Earth’s rising average temperatures and results of this change | | | | |
|------------------------|-----------|--|-------|-------|--------|------|---|-------|-------|--------|------|
| | | % | SE | Mean | SE | Sig. | % | SE | Mean | SE | Sig. |
| Albania | Before | 33.7 | (5.6) | 489.0 | (10.5) | | 25.1 | (5.5) | 472.4 | (18.3) | |
| | This year | 21.5 | (4.3) | 490.5 | (10.2) | | 29.2 | (5.4) | 487.9 | (9.9) | |
| | Not yet | 44.9 | (5.8) | 465.9 | (11.8) | | 45.7 | (4.9) | 476.9 | (8.1) | |
| Belgium (Flemish) | Before | 8.8 | (2.5) | 495.1 | (6.5) | | 4.5 | (1.5) | 499.2 | (12.1) | |
| | This year | 23.0 | (3.6) | 502.8 | (5.7) | | 50.3 | (4.1) | 494.9 | (5.2) | |
| | Not yet | 68.2 | (3.8) | 487.7 | (4.0) | * | 45.2 | (4.2) | 487.6 | (5.2) | |
| Belgium (French) | Before | 8.5 | (2.1) | 475.4 | (13.7) | | 7.8 | (1.6) | 473.9 | (11.1) | |
| | This year | 18.5 | (3.0) | 472.9 | (6.3) | | 23.9 | (3.0) | 477.5 | (6.6) | |
| | Not yet | 73.0 | (3.2) | 485.7 | (3.5) | | 68.3 | (3.1) | 485.2 | (3.9) | |
| Bosnia and Herzegovina | Before | 13.5 | (3.5) | 456.0 | (9.8) | | 0.8 | (0.7) | 487.0 | (49.7) | |
| | This year | 41.4 | (5.8) | 456.7 | (6.9) | | 14.7 | (3.4) | 453.4 | (9.4) | |
| | Not yet | 45.1 | (5.7) | 439.1 | (8.6) | | 84.5 | (3.4) | 447.0 | (5.4) | |
| Bulgaria | Before | 34.2 | (3.6) | 565.3 | (8.8) | | 15.4 | (2.9) | 552.6 | (17.1) | |
| | This year | 55.9 | (3.5) | 522.8 | (9.7) | | 36.9 | (4.1) | 535.1 | (11.2) | |
| | Not yet | 9.9 | (2.0) | 491.5 | (25.8) | * | 47.7 | (4.3) | 529.8 | (9.7) | |
| Cyprus | Before | 36.1 | (3.2) | 483.5 | (4.4) | | 12.0 | (2.6) | 487.2 | (10.7) | |
| | This year | 13.9 | (2.4) | 493.5 | (12.6) | | 24.1 | (2.9) | 472.3 | (6.4) | |
| | Not yet | 50.0 | (3.6) | 473.1 | (4.8) | | 63.8 | (3.2) | 481.3 | (3.6) | |
| Czech Republic | Before | 16.7 | (2.4) | 516.0 | (5.9) | | 4.4 | (1.0) | 512.4 | (8.8) | |
| | This year | 63.4 | (2.9) | 521.6 | (3.6) | | 29.1 | (3.0) | 519.8 | (5.8) | |
| | Not yet | 19.9 | (2.6) | 518.1 | (4.7) | | 66.5 | (3.0) | 519.3 | (3.1) | |
| Denmark | Before | 20.9 | (3.6) | 541.1 | (7.0) | | 12.9 | (2.8) | 533.4 | (7.4) | |
| | This year | 44.7 | (4.6) | 536.5 | (4.6) | | 54.3 | (4.1) | 538.2 | (4.9) | |
| | Not yet | 34.4 | (4.2) | 533.2 | (5.6) | | 32.8 | (4.0) | 534.5 | (5.6) | |

(continued)

Table 4.17 (continued)

| Education system | | Earth science: Physical characteristics of Earth | | | | | Earth science: Earth's rising average temperatures and results of this change | | | | |
|------------------|-----------|--|-------|-------|--------|------|---|-------|-------|--------|------|
| | | % | SE | Mean | SE | Sig. | % | SE | Mean | SE | Sig. |
| Finland | Before | 29.7 | (2.8) | 550.0 | (4.5) | | 9.9 | (1.8) | 540.8 | (8.0) | |
| | This year | 47.9 | (3.5) | 541.9 | (4.6) | | 37.1 | (2.6) | 548.1 | (4.6) | |
| | Not yet | 22.4 | (2.8) | 534.1 | (5.7) | | 53.1 | (2.5) | 539.4 | (3.7) | |
| France | Before | 27.1 | (3.2) | 496.8 | (6.0) | | 5.8 | (2.7) | 507.0 | (19.5) | |
| | This year | 35.5 | (3.8) | 496.5 | (5.7) | | 32.2 | (3.3) | 493.2 | (4.2) | |
| | Not yet | 37.4 | (4.3) | 494.7 | (6.9) | | 62.0 | (3.9) | 496.3 | (5.4) | |
| Germany | Before | 19.7 | (3.3) | 515.1 | (6.9) | | 23.9 | (3.2) | 511.5 | (5.5) | |
| | This year | 37.4 | (3.5) | 521.2 | (5.1) | | 37.0 | (3.4) | 518.7 | (5.8) | |
| | Not yet | 42.8 | (3.5) | 507.7 | (5.6) | | 39.1 | (3.5) | 508.6 | (5.3) | |
| Hungary | Before | 21.9 | (3.5) | 537.1 | (10.8) | | 7.8 | (1.8) | 564.0 | (8.3) | |
| | This year | 60.1 | (4.1) | 534.2 | (5.6) | | 48.4 | (4.1) | 535.8 | (5.3) | |
| | Not yet | 18.0 | (3.3) | 523.9 | (9.3) | | 43.8 | (4.0) | 524.4 | (7.4) | * |
| Ireland | Before | 26.5 | (3.5) | 537.5 | (5.8) | | 13.2 | (2.6) | 523.4 | (11.0) | |
| | This year | 48.9 | (4.4) | 536.4 | (5.9) | | 68.8 | (3.3) | 540.5 | (4.6) | |
| | Not yet | 24.7 | (3.8) | 533.1 | (6.6) | | 18.0 | (3.0) | 528.3 | (6.7) | |
| Italy | Before | 28.3 | (3.1) | 518.6 | (4.5) | | 12.9 | (2.3) | 509.6 | (8.2) | |
| | This year | 60.4 | (3.6) | 515.9 | (3.9) | | 57.2 | (3.9) | 521.7 | (3.5) | |
| | Not yet | 11.3 | (2.1) | 523.1 | (7.6) | | 29.9 | (3.7) | 512.9 | (5.8) | |
| Kosovo | Before | 22.5 | (3.6) | 404.8 | (7.3) | | 12.5 | (2.6) | 392.2 | (5.7) | |
| | This year | 51.2 | (4.3) | 394.4 | (6.0) | | 48.0 | (4.4) | 392.3 | (6.5) | |
| | Not yet | 26.3 | (3.8) | 415.9 | (6.6) | * | 39.6 | (4.3) | 417.4 | (5.6) | * |
| Latvia | Before | 52.3 | (4.3) | 505.5 | (4.5) | | 21.7 | (3.3) | 510.9 | (5.8) | |
| | This year | 11.7 | (2.6) | 505.8 | (9.4) | | 20.9 | (3.5) | 508.3 | (7.8) | |
| | Not yet | 36.0 | (3.9) | 500.5 | (5.6) | | 57.4 | (4.1) | 500.2 | (4.6) | |

(continued)

Table 4.17 (continued)

| Education system | | Earth science: Physical characteristics of Earth | | | | | Earth science: Earth's rising average temperatures and results of this change | | | | |
|-----------------------|-----------|--|-------|-------|--------|------|---|-------|-------|--------|------|
| | | % | SE | Mean | SE | Sig. | % | SE | Mean | SE | Sig. |
| Lithuania | Before | 52.2 | (3.5) | 522.2 | (4.6) | | 34.2 | (3.2) | 518.7 | (6.3) | |
| | This year | 45.2 | (3.6) | 518.0 | (4.8) | | 50.8 | (3.7) | 521.5 | (3.9) | |
| | Not yet | 2.6 | (1.0) | 534.2 | (16.0) | | 14.9 | (2.6) | 521.8 | (7.6) | |
| Montenegro | Before | 18.0 | (2.4) | 463.6 | (6.3) | | 4.1 | (0.8) | 452.3 | (11.1) | |
| | This year | 55.7 | (2.9) | 466.9 | (3.5) | | 21.5 | (2.4) | 479.7 | (5.6) | |
| | Not yet | 26.3 | (2.9) | 464.3 | (5.1) | | 74.5 | (2.5) | 462.4 | (2.6) | * |
| Netherlands | Before | 19.0 | (4.5) | 528.0 | (6.7) | | 6.0 | (2.3) | 497.9 | (15.2) | |
| | This year | 41.1 | (5.3) | 514.8 | (4.2) | | 60.5 | (4.7) | 522.0 | (3.7) | |
| | Not yet | 39.9 | (4.7) | 519.1 | (5.2) | | 33.5 | (4.3) | 517.3 | (5.6) | |
| N. Macedonia, Rep. of | Before | 22.2 | (3.2) | 426.9 | (10.3) | | 17.0 | (2.9) | 427.4 | (11.1) | |
| | This year | 64.3 | (3.6) | 439.6 | (6.7) | | 53.3 | (4.1) | 435.7 | (7.8) | |
| | Not yet | 13.5 | (2.4) | 442.7 | (16.5) | | 29.7 | (3.5) | 446.0 | (10.8) | |
| Poland | Before | 4.8 | (1.6) | 552.2 | (10.3) | | 0.8 | (0.8) | 539.8 | (0.0) | |
| | This year | 79.9 | (3.5) | 557.6 | (2.8) | | 12.5 | (2.3) | 555.1 | (5.4) | |
| | Not yet | 15.3 | (3.1) | 555.6 | (7.1) | | 86.7 | (2.5) | 557.4 | (2.6) | |
| Portugal | Before | 35.0 | (3.3) | 512.8 | (5.1) | | 36.7 | (2.7) | 514.0 | (5.3) | |
| | This year | 63.1 | (3.3) | 521.9 | (4.4) | | 52.8 | (2.9) | 520.3 | (4.3) | |
| | Not yet | 1.9 | (1.1) | 491.8 | (10.4) | | 10.5 | (2.0) | 522.0 | (10.9) | |
| Romania | Before | 40.0 | (5.2) | 530.4 | (7.3) | | 25.7 | (4.5) | 524.0 | (7.4) | |
| | This year | 52.3 | (4.8) | 521.5 | (7.8) | | 68.1 | (4.7) | 527.3 | (7.2) | |
| | Not yet | 7.7 | (2.7) | 527.6 | (23.6) | | 6.2 | (2.4) | 512.9 | (20.8) | |

(continued)

Table 4.17 (continued)

| Education system | | Earth science: Physical characteristics of Earth | | | | | Earth science: Earth's rising average temperatures and results of this change | | | | |
|------------------|-----------|--|-------|-------|-------|------|---|-------|-------|--------|------|
| | | % | SE | Mean | SE | Sig. | % | SE | Mean | SE | Sig. |
| Serbia | Before | 57.2 | (4.0) | 519.1 | (3.9) | | 22.5 | (3.0) | 517.6 | (4.9) | |
| | This year | 22.2 | (3.4) | 514.9 | (7.2) | | 25.8 | (3.5) | 515.9 | (6.5) | |
| | Not yet | 20.6 | (3.1) | 514.0 | (6.7) | | 51.6 | (4.1) | 518.8 | (4.7) | |
| Slovak Republic | Before | 31.3 | (3.0) | 522.4 | (6.6) | | 11.1 | (2.0) | 531.8 | (9.5) | |
| | This year | 25.3 | (2.9) | 508.5 | (9.6) | | 30.5 | (2.6) | 518.8 | (7.0) | |
| | Not yet | 43.3 | (3.2) | 499.6 | (6.9) | | 58.3 | (3.1) | 499.6 | (4.9) | * |
| Slovenia | Before | 23.4 | (2.8) | 528.6 | (5.0) | | 3.0 | (1.1) | 519.0 | (10.8) | |
| | This year | 47.8 | (3.7) | 517.9 | (3.5) | | 28.6 | (3.3) | 524.5 | (4.1) | |
| | Not yet | 28.8 | (3.2) | 517.9 | (4.2) | * | 68.4 | (3.5) | 518.9 | (3.3) | |
| Spain | Before | 39.3 | (3.2) | 511.2 | (3.5) | | 19.7 | (2.3) | 508.1 | (4.3) | |
| | This year | 53.4 | (3.1) | 508.0 | (3.7) | | 58.5 | (2.9) | 512.1 | (3.6) | |
| | Not yet | 7.2 | (1.4) | 519.7 | (7.2) | | 21.7 | (2.3) | 506.8 | (4.1) | |
| Sweden | Before | 8.9 | (1.9) | 535.4 | (7.2) | | 7.4 | (2.3) | 527.4 | (9.5) | |
| | This year | 53.5 | (4.5) | 524.8 | (4.6) | | 52.9 | (4.1) | 534.2 | (3.9) | |
| | Not yet | 37.6 | (4.4) | 535.7 | (5.2) | | 39.7 | (4.3) | 524.2 | (5.2) | |

Note: Standard errors appear in parentheses

*Significant difference between the mean scale scores at the time of teaching

Table 4.18 How often teachers do environmental activities in classes and student environmental knowledge

| Education system | Develop students' positive attitudes toward the natural environment | Encourage students to use less resources | Discuss how student actions in and outside of school help the natural environment | Discuss environmental issues |
|------------------------|---|--|---|------------------------------|
| Poland | ● | ○ | ○ | ○ |
| Finland | ● | ○ | ○ | ○ |
| Ireland | ○ | ● | ○ | ○ |
| Denmark | ○ | ○ | ○ | ○ |
| Hungary | ● | ● | ● | ○ |
| Bulgaria | ● | ● | ● | ● |
| Sweden | ○ | ○ | ○ | ○ |
| Romania | ● | ● | ● | ● |
| Lithuania | ● | ● | ○ | ○ |
| Czech Republic | ● | ○ | ○ | ○ |
| Slovenia | ● | ● | ● | ○ |
| Netherlands | ○ | ○ | ○ | ○ |
| Portugal | ● | ● | ● | ○ |
| Italy | ● | ● | ● | ● |
| Serbia | ● | ● | ● | ○ |
| Germany | ● | ○ | ○ | ○ |
| Spain | ● | ● | ● | ○ |
| Slovak Republic | ● | ● | ○ | ○ |
| Latvia | ● | ○ | ○ | ○ |
| France | ○ | ○ | ○ | ○ |
| Belgium (Flemish) | ○ | ○ | ○ | ○ |
| Belgium (French) | ○ | ○ | ○ | ○ |
| Cyprus | ● | ○ | ○ | ○ |
| Albania | ○ | ○ | ○ | ○ |
| Montenegro | ● | ● | ● | ○ |
| Bosnia and Herzegovina | ● | ● | ● | ○ |
| NM Macedonia, Rep. of | ● | ● | ● | ● |
| Kosovo | ● | ○ | ● | ● |
| Table average | ● | ○ | ○ | ○ |

Notes: Education systems are ordered according to the national mean student achievement in environmental knowledge; see Table 4.2; ●, at least once a week; ○, once or twice a month (Other possible options were a few times a year, or never/almost never.)

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