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Perceptions of Sustainability among Children and Teachers: Problems Revealed via the Lenses of Science Communication and Transformative Learning

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Abstract: Scholars and policymakers see sustainability as depending on the inter-relationships between the three pillars of the environment, society, and the economy. However, it remains less clear how key stakeholders with a responsibility for educating the next generation perceive the concept of sustainability and act accordingly. In order to gain new insights, this research scrutinises participant perceptions of sustainability and climate change in two eco-schools in England for primary children (aged 5–11 years). Our case study involved individual interviews with classroom teachers and headteachers, group interviews with fourth- and fifth-year students (ages 10–12 years), and in-class observations. We also analysed data from student exercise books and photographs of school grounds to understand participants' self-reported knowledge and perceptions of sustainability and climate change. Within a framework drawing on theories of science communication and transformative learning (a learning approach based on having challenging experiences), the results show that the integration of sustainability into the curriculum was limited and problematic. That is despite the fact that all students and teachers were aware of the environmental dimensions of sustainability, such as climate change and the overuse of natural sources. These findings suggest that schools are no different to other institutional settings when it comes to dealing with the challenges of integrating sustainability into daily practice. We conclude that there is a need for in-service teacher education programmes to enable and motivate teachers to provide richer teaching-learning environments so as to enable effective learning in schools about sustainability and climate change.

Keywords: sustainability; climate change; primary schools; transformative learning; science communication

Citation: Gelmez Burakgazi, S.; Reiss, M.J. Perceptions of Sustainability among Children and Teachers: Problems Revealed via the Lenses of Science Communication and Transformative Learning. *Sustainability* **2024**, *16*, 4742. https://doi.org/10.3390/su16114742

Academic Editors: Will Rifkin, Heather J. Bray, Martin Espig and Robert Perey

Received: 11 March 2024
Revised: 27 May 2024
Accepted: 30 May 2024
Published: 2 June 2024

1. Introduction

Sustainability as a hybrid concept has had a crucial place in public and political agendas since well before the reports in *Our Common Future* in 1987 [1] and *Agenda 21* in 1992 [2]. As per the United Nations' Brundtland report, sustainability involves "meet[ing] the needs of the present without compromising the ability of future generations to satisfy their own needs" [1]. UNESCO (2005) defines three sustainability dimensions—environmental, social, and economic. This focus reflects that education has considerable potential to facilitate changes in attitudes, values, and behaviours from generation to generation to enable sustainability to become more embedded within society.

Sustainability is gradually becoming an important aspect at all levels of education. Education for Sustainable Development (ESD) was promoted in the United Nations Decade of Education for Sustainable Development [UNDESD] (2005–2014) [3], following the UNESCO Global Action Programme for ESD (Education for Sustainable Development) (2015–2019) [4] and then the 'ESD for 2030' framework from 2020 to 2030 [5]. Over the past two decades, there have been calls to integrate sustainability into the curriculum: "all learners acquire the knowledge and skills needed to promote sustainable development, including, among

others, through education for sustainable development" (target 4.7, [5] (p. 21)). By providing such a common ground, curricula can harmonise and integrate economic, social, and environmental pillars in the minds of those who will soon be making pivotal decisions in their daily lives.

As sustainability is defined as a field beyond disciplinary anchoring by some researchers (e.g., [6]), various subjects faced by school students might contribute to these three pillars in the following way: Environment—natural resources, climate change, rural development, sustainable urbanisation, disaster prevention and mitigation; society—human rights, gender equity, peace and human security, health, HIV/AIDS, governance, cultural diversity, and inter-cultural understanding; economy—poverty reduction, corporate responsibility, and the market economy [7].

School education can act as a catalyst for change through the curriculum, student-centred teaching methods, future-oriented thinking, higher-order thinking skills, critical thinking, interdisciplinarity, and linking local and global issues. According to [8], the current generation of school students is the first to have to deal with global socio-economic, political, and demographic realities. This viewpoint ties our local, everyday actions to global events, necessitating the development of a global awareness to influence change from private to general and address global challenges in a sustainable way.

Education for sustainable development—at the school level and in further and higher education—is aimed at educating individuals in accordance with sustainable development principles, such as knowledge, attitudes, values, and behaviour, through programmes that address environmental, economic, and social issues [9]. The Rio+20 Conference reaffirmed that universal access to primary education and quality education at all levels is an "essential condition for achieving sustainable development" [9] (p. 59). However, these efforts do not as yet seem to have catalysed the necessary changes to meet today's increasingly complex problems [10,11].

The role of school education has also been emphasised by the UN Department of Economic and Social Affairs as being critical for ensuring sustainable development and improving the capacity of people to address environmental and developmental issues. In addition to that, both formal and non-formal education, for both children and adults, play crucial roles in altering individuals' attitudes, enabling them to evaluate and tackle their sustainable development concerns. Furthermore, it is commonly accepted that school education is crucial for attaining environmental and ethical consciousness, values, attitudes, skills, and conduct that align with sustainable development, as well as facilitating effective public participation in decision-making by helping to ensure that the next generation of adults are informed about relevant issues and are able to discuss these issues with their fellow citizens. To give just one example, the standards include that "each practitioner [likely refers to individuals who are actively involved in the field of education, particularly those who work directly with students in schools e.g., teachers, school administrators, educational psychologists, counselors] school and education leader should demonstrate learning for sustainability through their practice" [12].

Climate change is one of the critical goals under the Sustainable Development Agenda. According to the data from the Office for National Statistics collected in September–October 2022, "Around three in four adults (74%) in Great Britain reported feeling (very or somewhat) worried about climate change"; this is the second-biggest concern behind the rising cost of living (79%) [13]. However, the voices of children and young people are largely absent from climate change coverage [14]. On that point, in highlighting one of the greatest public policy issues of our time, one that challenges countries across the world, in a Policy Paper published in 2023, the Secretary of State for Education in England explained the following:

> The challenge of climate change is formidable. For children and young people to meet it with determination, and not with despair, we must offer them not just truth, but also hope. Learners need to know the truth about climate change—through knowledge-rich education. They must also be given the hope that they

> can be agents of change, through hands-on activity and, as they progress, through guidance and programmes allowing them to pursue a green career pathway in their chosen field. [15]

At present, an inspection of the National Curriculum in England shows that such views are not reflected in it. When the National Curriculum is next revised—as a date as yet unspecified—it remains to be seen whether such views are embedded in official discourse.

In common with a number of other countries (e.g., Sweden, Japan, Singapore and Turkey), England has had, since 1989, a statutory National Curriculum, though an increasing proportion of schools are exempted from it (e.g., because they are independent—i.e., fee-paying—or because they are classified as 'academies'). The National Curriculum in England delineates the programmes of study and attainment targets for each school subject across all four compulsory key stages (ages 5–7, 7–11, 11–14, 14–16). The National Curriculum for England stipulates that:

> All schools should make provision for personal, social, health and economic education, drawing on good practice. Schools are also free to include other subjects or topics of their choice in planning and designing their own programme of education. [16] (2.5)

An increasing proportion of schools (independent schools and those that are Academies or Free Schools) sit outside the formal requirements of the National Curriculum but a school's curriculum in England is not entirely determined by the National Curriculum, even for those schools subject to the National Curriculum. From September 2012, all schools have been required to publish their school curriculum by subject and academic year online [16] (2.4). That makes them more open to scrutiny, in this case, in relation to how they address sustainability.

Such scrutiny is becoming increasingly important as, in the last two decades or so, sustainability science, as a transdisciplinary domain, has offered a rich environment for crafting alternative paradigms that are more effective for tackling intricate sustainability issues [17]. This study looks at the impact of this sustainability science in school curricula, which is mainly based on the investigation of the pillars of sustainability—environment, economy, and society—through the lenses of science communication and transformation theory.

1.1. Transformation Theory

Transformation theory, also referred to as transformative learning theory, is a learning theory drawn from the field of education specifically and the social sciences more generally. It:

> (. . .) deals with how individuals may be empowered to learn to free themselves from unexamined ways of thinking that impede effective judgment and action. It also envisions an ideal society composed of communities of educated learners engaged in a continuing collaborative inquiry to determine the truth or arrive at a tentative best judgment about alternative beliefs. Such a community is cemented by empathic solidarity, committed to the social and political practice of participatory democracy, informed through critical reflection and would collectively take reflective action, when necessary, to assure that social systems and local institutions, organizations and their practices are responsive to the human needs of those they service. [18]

This vision for transformation refers to the role of school education, along with other forms of education, as a catalyst for change. In the field of school education, there is no doubt that the environmental crisis and other existential threats (e.g., those from the nuclear industry, pandemics, and AI [19]) require changes in the way many people live, think, and act. Responding to this call—within the frame of reference of transformation theory—will require change in individual lives and through collective action that recognises unsustainability, strives for equitable societies, and creates sustainable conditions. This shift will not be easy, as discussed in [20]: "This change is perhaps already in the air,

however, faintly. But our tradition, education, current activities, and interests will make the transformation embattled and slow" (p. 195). At the same time, repeated and widespread adverse events, such as those arising from pandemics, climate change, and biodiversity loss, force many people to reconsider their lives, thoughts, and actions. This kind of change can occur when transformative learning is effective; it involves shifting frames of reference through critical observations of both habits and perspectives [18]. Our argument is that transformative learning, often seen as being applicable to adults and young adults, is also applicable to children of primary age and may be needed, given the current climate change, biodiversity, and sustainability crisis.

1.2. Science Communication

Integrating a sustainability lens into science communication can be seen as one avenue to being transformative. Science communication can be defined as the skilful use of various tools, media, activities, and dialogue to elicit one or more of the personal responses to science: awareness, enjoyment, interest, opinions, and understanding [21]. Since the 1990s, science communication has emerged as a multidisciplinary field connected to communication, education, the natural sciences, the social sciences, and various other areas. It can be defined as the production, circulation, and reliable utilisation of knowledge among scientists, society, policymakers, industry, and other stakeholders [22]. Over the last 30 years, science communication activities have encompassed a range of approaches [22], from top-down, one-way/unidirectional models, highlighting a deficit in knowledge and means to boost understanding, to interactive public engagement and public participation models. A useful distinction can be made between 'first-order' models of science communication, which stress deficits, 'second-order' models, which emphasise the value of public engagement and dialogue, and 'third-order' models, which ask fundamental questions about the relationship between first- and second-order approaches, the changes that have taken place in the theory and practice of science communication, and its future direction [23].

However, in an age of misinformation, how successfully institutional attempts at science communication handle the issues [24] that capture the attention of various publics, e.g., COVID-19, climate change, and the theory of evolution, is arguable. It has been proposed that the objectives of science communication can be classified into at least six categories: securing the accountability and legitimacy of publicly funded science; enabling informed decisions by laypeople and policymakers in today's technologically driven societies; bolstering democracy by empowering citizens; offering access to the aesthetic aspects of science as a cultural element; serving promotional goals, such as those seen in 'university PR'; and fulfilling an economic role by attracting individuals to scientific careers or preparing a market foundation for technological innovations [25].

Via these definitions of science communication, one can see its relevance to the efforts of scientists highlighting the threats of anthropogenic climate change, which they have been attempting to do since at least 1957 [26]. This extended timeline is not a source of pride, and if it requires such a prolonged effort to engage public attention in the next crucial environmental phase, we are likely to encounter significant challenges, such as the Pacific Islands and many other coastal communities facing inundation from rising sea levels. For this reason, the efficacy of scientific communication can be questioned in terms of its functions in such circumstances as the climate crisis, vaccine rejection, and the problem of access to clean water in a number of countries. Amidst such challenges, it is generally held that science communication is important for fostering informed public discourse, influencing policy decisions, and addressing global issues collaboratively.

Despite their differences, there is considerable similarity between conducting science communication successfully and implementing effective educational strategies in schools and other settings. Both disciplines—education and science communication—share a number of points: tailoring the message to the audience; building trust with the audience; initiating an interactive dialogue rather than a one-way monologue; and seeking what one

communicates or teaches to enhance awareness, enjoyment, understanding, the formation of valid opinions, and interest.

From these two perspectives—transformation theory and science communication—we recognised an opportunity to examine the effectiveness of curriculum decisions and the adoption of a sustainability frame of reference across classroom teachers, headteachers, and students. We attempt to address this issue by answering the following research questions through the examination of actors and activities in two primary eco-schools in England:

1. What are primary teachers' and fourth- and fifth-grade students' knowledge and how do they perceive sustainability and climate change?
2. What kind of features do participant schools have with regard to the environmental, social, economic, and educational dimensions of sustainable development-oriented education?
3. From the participants' perspectives, what are the challenges and opportunities of their schools by having an orientation toward sustainability?
4. What information sources do the teachers and fourth- and fifth-grade students use in learning about sustainability issues?
5. How is environmental and sustainability education enacted and experienced in primary eco-schools from the perspectives of classroom teachers, headteachers, and fourth- and fifth-grade students?

The investigation of these questions, from the conceptual reference points just explained, reveals ongoing challenges, where the integration of sustainability into the curriculum was limited and problematic.

2. Materials and Methods

This qualitative case study is "an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process, or a social unit" [27] (p. xiii). Accordingly, two primary schools in England with a designated focus on sustainability issues jointly constitute the case. Based on the research questions, the study has the following objectives:

Objective 1: To assess the knowledge levels and perceptions of sustainability and climate change among primary teachers and fourth- and fifth-grade students.

Objective 2: To investigate the environmental, social, economic, and educational dimensions of sustainable development-oriented education within participant schools.

Objective 3: To explore the challenges and opportunities perceived by stakeholders within participant schools regarding orientation toward sustainability.

Objective 4: To identify the primary information sources utilised by teachers and fourth- and fifth-grade students for learning about sustainability issues.

Objective 5: To examine the enactment and experiences of environmental and sustainability education in primary eco-schools from the perspectives of classroom teachers, headteachers, and fourth- and fifth-grade students.

2.1. Data Collection Instruments

Interview forms: Individual and group interview protocols were developed separately for headteachers, classroom teachers, eco-team leaders, and students, and these were undertaken in both schools. The semi-structured interview protocol (Appendix A) had two sections. Section 1 focused on demographics, including year of birth, the most recent degree received, and teaching experience (for teachers and headteachers). Section 2 consisted of the main interview questions, e.g., "Can you please try to explain to me what you understand by 'sustainability'?" and "What do you think about the strengths and weaknesses concerning the implementation of sustainability in your school?".

While our research instruments were not initially developed with direct reference to transformation theory and science communication, we found that these theoretical frameworks provided valuable lenses through which to interpret and make sense of our empirical findings. As we engaged in the analysis of our data, we observed patterns and

themes that resonated with key concepts from transformation theory, such as processes of individual and societal change towards sustainability, and uses of media in accessing science and engagement with scientific issues.

In total, 12 fourth- and 12 fifth-year students participated in four group interviews, and two eco-team leaders, two headteachers, and five classroom teachers participated in individual interviews. The interviews were audio-recorded and transcribed. We acknowledge that this sample size is not large, but it is not atypical for a qualitative case study [28], and our findings revealed considerable commonalities among the interviewee responses, which we will go on to discuss, indicating that a quite high degree of data saturation had been reached.

Observations: A total of 35 h (typical of rapid ethnographies [29]) of in-class observations were conducted in School 1 with Year 4 and Year 5 groups in science, geography, English, and mathematics classes. During observations, detailed and timed field notes were generated.

Documents: Student exercise books (Reading, Science, and Geography notebooks, totalling 24 notebooks of about 40 pages each) were collected, and photographs (82 photographs from both schools) of the school buildings and grounds were taken in both schools. The relevant parts of the National Curriculum for England were examined. The student exercise books were examined to look for evidence of sustainability in student activities.

2.2. Study Group

The schools were recruited based on criterion sampling with two pre-determined criteria: (1) being a Green Flag eco-school; (2) being an "Outstanding School" based on the 2011 Ofsted reports (the highest grade on a four-point scale). An eco-school follows a framework that seeks to enable its students to make a difference with respect to environmental issues. Schools that are deemed to have successfully implemented the framework are accorded Green Flag status [28]. Both schools were state schools in London with predominantly white, middle-class catchment areas, subject to the National Curriculum for England.

Fourth- and fifth-year students were invited to join the study based on teacher suggestions. These year groups were particularly suitable for our purposes because of the shortage of research regarding this age range, despite the fact that sustainability is often taught in England from a young age.

Both schools had big school grounds, including a wooded area, green fields, and a range of play areas. The photographs in Figure 1 provide an impression of both schools and their grounds. They include views of the grounds, examples of student work on public display, vegetation, a pond, cycle racks, and recycling facilities to give an idea of the schools' contexts.

In the images on the left side (School 1) of Figure 1, there are examples of student work on the topic of 'Where does our local food come from?', which are displayed on the main school board, a 'Recycle in a Fun Way' poster, the bicycle parking areas, the school garden, and an area for plastic bottle recycling. As reported in an official 2022 School Inspection report, School 1 initiates facilities aimed at enhancing recycling efforts and minimising the use of single-use plastic within the school. The photographs on the right (School 2) show the school pond, recycling bins, publicly displayed student work made from waste materials, and a reusable bag with the text, 'What can I recycle?'.

Figure 1. Photographs to Illustrate the state of environmental sustainability in School 1 (**left**) and School 2 (**right**).

2.3. Data Collection Procedures

After receiving the required permissions, data were collected from the two schools between April and July 2022. School 2 allowed students, the eco-team leader, and the headteacher to be interviewed and the student exercise books to be examined, with photographs of the school, including its grounds, taken, but the school did not give permission for observations or for classroom teachers to be interviewed, owing to the time pressures on the classroom teachers.

All aspects of the study were approved by the University College London Research Ethics Committee (ID Number: Z6364106/2022/04/05). In line with this approval, abbreviations were used for the participants to enable pseudonymisation (e.g., T1, T2, and T3 for the classroom teachers; HT1 and HT2 for the headteachers; S1, S2, and S3 for the students; Sch1 and Sch2 for the schools).

2.4. Demographic Profiles of the Participants

The participating students were 9 or 10 years old. Academically, they were said to be (by their teachers mainly) performing at or above the levels expected for their age.

The teachers' ages and professional experience varied, ranging from those who were in the early years of their professional careers to those with more than 25 years of experience (often in other schools as well as their present school). The ages of the teachers ranged from 27 to 53. Further information is provided in Table 1.

Table 1. Demographic profiles of the teacher participants.

	School Role	Gender	Age	Class Year	Educational Background	Experience (in Years)
T1	Classroom teacher	F	44	5	Teacher training	5
T2	Classroom teacher	F	34	4	Education and psychology. Currently doing a master's degree	10
T3	Classroom teacher (science specialist)	F	48	4	Education	10
HT1	Headteacher	F	46	-	Special education	22
HT2	Headteacher	M	51	-	Anthropology and geography	24
T4	Eco-team leader	F	27	-	Psychology	2
T5	Eco-team leader	F	53	-	Biology	20

2.5. Data Analysis

We used thematic analysis [30] to analyse the transcripts of the individual and group interviews and our observation notes. Because of the intention of the study to examine the range of ways in which sustainability was present (or not), deductive coding was used, meaning that the themes—environmental, social, economic, and educational dimensions of sustainability—were derived from the literature in a top-down, rather than bottom-up, way, on the grounds that this would help us answer our research questions.

2.6. Reliability and Validity of the Study

Qualitative research typically "does not claim to be replicable" [31] (p. 204), as the implicit assumption of a stable (i.e., repeatable) world is in direct contrast to the nature of the qualitative presumption [31]. Accordingly, reliability is not understood in qualitative research in the same way as it typically is in quantitative research. Nevertheless, it is standard in qualitative research to attempt to ensure that the findings are trustworthy [27], a term that combines elements of reliability and validity.

In order to enhance the trustworthiness of the study [32,33], we employed prolonged engagement (the first author satisfied this criterion by observing classes through the summer term for 14 weeks, totalling 35 h of observation), triangulation (in terms of data collection instruments, i.e., interviews, observations, and documents, with triangulation in terms of sources of information, i.e., students, teachers, and headteachers), expert review (for the data analysis), thick (i.e., rich and meaningful) descriptions (throughout the study), and member checking (the transcripts were sent to the adult interviewees for feedback on their accuracy).

3. Results

> "*So, there's something about, you're not necessarily doing it for yourself, but you're doing it for the greater good*". (HT1)

We organise our findings according to our five research questions. The richest data came from the interviews, but we also used data from our observations and the student

exercise books (e.g., Figure 2). Of the four dimensions of sustainability, the most in evidence in each of the schools were the environmental (e.g., climate change and water scarcity) and economic (e.g., consumption and renewable energies) dimensions. When quotations are given, no attempt has been made to 'tidy up' the language used.

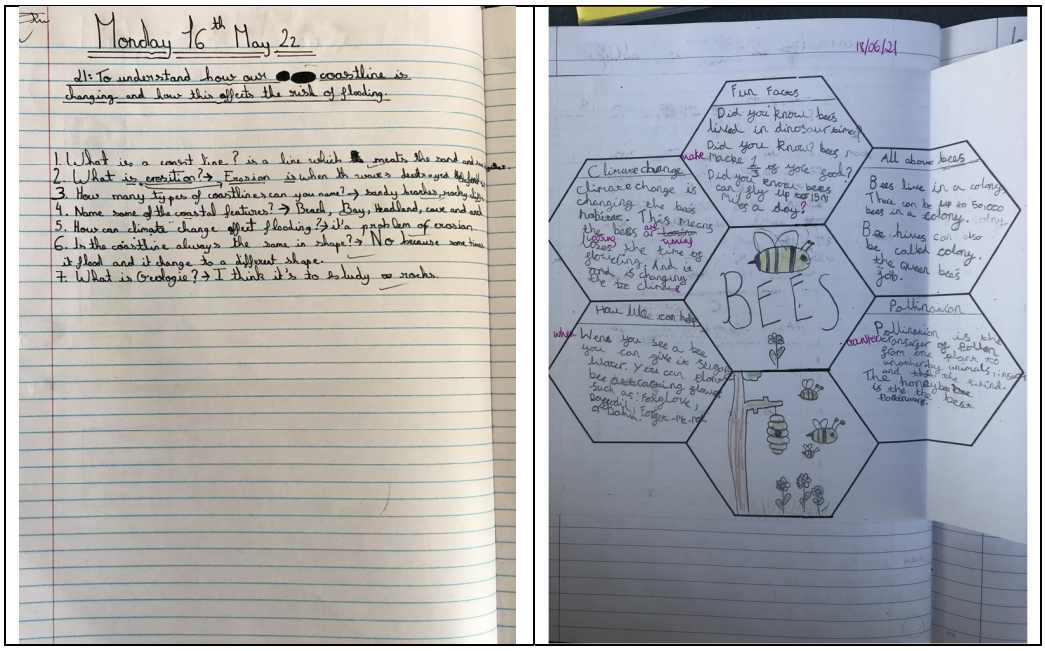

Figure 2. Images from student exercise books showing issues related to sustainability: School 1, Year 5 (**left**); School 2, Year 5 (**right**).

3.1. Teachers' and Fourth- and Fifth-Grade Students' Knowledge and Their Perceptions of Sustainability and Climate Change

Most participants rated their personal understanding of sustainability (see Appendix A) as "reasonable" or "good". Environmental problems, such as climate change and pollution, were conceptualized to be the consequence of decisions and actions by humans:

> (. . .) the issue is, is it's the, the impact we've had, so the global warming side of things, because of our emissions and our actions. And over such a tiny period of time. (T5)

For the participants in this study, the most commonly cited environmental problems facing the world today were global warming (HT1, HT2, T1, T2, T3, S5-Yr5-Sch1); pollution (HT1, T1, T3, S3-Yr4-Sch1, S4-Yr1-Sch1, S2-Yr4-Sch1); climate change (S3-Y4-Sch1, S3-Yr5-Sch1); deforestation (T1, S2-Yr4-Sch1, S6-Yr5-Sch2); energy (ET1, ST1); ozone layer depletion (S3, S5-Yr5-Sch1); food waste (HT1, S3-Yr4-Sch1); floods (S4-Yr5-Sch1); toxicity (HT2); overpopulation (T1); consumerism (T2); and carbon footprint (ST1) (Figure 3).

Both students and teachers invariably stated that students find sustainability to be important, and students reported that their teachers and parents also value environmental issues:

> I think that it really matters. Some people do it [give importance to a sustainable life], but we need more people around the world doing it. (S4, Yr5, Sch2)

> We can watch David Attenborough. And then, my parents tell me about. (S3, Yr4, Sch1)

> (. . .) And what we've got is significant, and irreversible damage being done to people's way of living in terms of their ability to perceive themselves as individuals and countries to sustain themselves. So I think what is going to inevitably happen is that there will be a rush for resources. And those resources

permit even more finite, what will probably happen is there'll be huge pressure on migration northwards towards more temperate environments. (HT2, Sch2)

For example, participants agreed that human activities affected the environment: "the way we affect the environment is like, is good and bad at the same time" (S5-Yr 4-Sch1). S2-Yr4-Sch2 gave an example of the negative impact of people on the environment—the use of vehicles, instead of increasing the use of bicycles or walking.

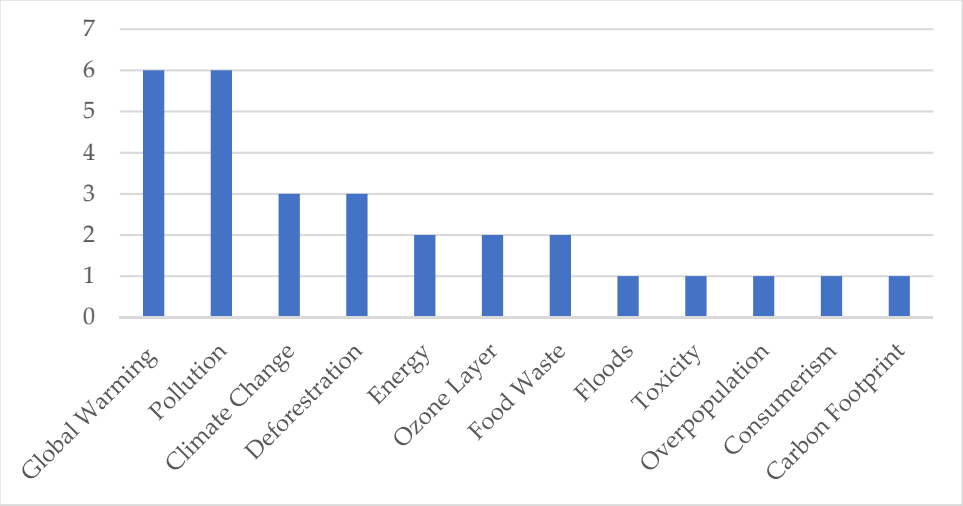

Figure 3. The most frequently cited environmental issues facing the world, as stated by interviewees.

In a dramatic reflection on the urgency of environmental action, HT1 articulated a pressing concern regarding the current trajectory of human impact on the planet. Delving into the insights derived from Griscom's book [33], the participant emphasised the approaching threat, cautioning that humanity stands on the brink of real danger: "Before we're in real danger, if you read according to Griscom book, that would be you know, and we, the fact is that we are still burning fossil fuels, we are trying to get across to electric cars. And we've done sorry, I'm quite I'm sort of a bit of like, we've done so much damage. And it's about educating the children about how not to continue that and what can change". This statement encapsulates the essence of a broader narrative emerging from participants within the study—highlighting the need to instil environmental awareness in children and foster a collective commitment to mitigating the detrimental effects of past actions.

For most of the participants, families, governments, and big companies (HT1) were seen to have the biggest roles in sustainability. According to the Year 4 student group interview, governments could allocate more funds to support the public and schools to be able to plant more trees in their gardens (S5), prevent people from cutting down trees (S2), and add extra zones [the ultra-low emission zone (ULEZ) is a zone in certain areas of London where vehicles need to meet strict emissions standards to enter without incurring a daily charge] as the cars are using too much fuel (S4).

Emphasising the role of the government in a similar vein, HT2 advocated for a shift in the curriculum, urging governments to prioritise essential aspects over outdated learning approaches:

> I think governments need to give schools resources. I think governments need to give schools time. I think governments need to take the pressure off from all the accountabilities that schools have so that schools have the space and energy and resources to develop the things that are really important. (. . .) Governments have a responsibility, I think, to do that, instead of what I think is quite an archaic and old-fashioned view of learning.

The Year 5 students at School 1 stated that they felt that governments could take more initiative on sustainability issues. Their recommendations ranged from advocating for the

construction of wind turbines to supporting the production of environmentally friendly vehicles. In a parallel vein, the Year 4 students at School 2 demonstrated a proactive approach to environmental stewardship within their school community: "teachers can give them extra time to pick up rubbish" (S6). The students in the School Club called 'Star Squad' [an example of an eco-group, discussed below] engaged in weekly gatherings where they not only discussed environmental concerns but also took tangible actions. For instance, they dedicated time to picking up litter and went to the school allotment, actively clearing weeds and removing what they saw as other impediments so as to contribute positively to the environment. This juxtaposition of perspectives and initiatives highlights the diversity of approaches within different school cohorts, collectively emphasising the importance of both advocating for systemic change and fostering hands-on, grassroots efforts for a sustainable future. In many ways, it is clear that the students were open to the possibility of transformational learning; indeed, a considerable number of them actively sought it.

However, some statements indicated that it was seen to be difficult to influence parents (HT1): "Parents don't like to be told and how they should do things. So, I think [it's] requesting parents say not to use the car to drop their children off to school is would be very difficult. (. . .) Our influence on them is very limited". On the other hand, for ST1, "I think some is better than none. But the thing is, you can launch these things. And I think if you if you infuse the children, if you encourage the children and work towards something, I think the families almost have to come along with it. Even if they don't really want to. And if you put positive reasons to support their child in it, I think they would do it".

The interviews showed that many participants take their own personal measures toward a sustainable world. These measures include using their own plastic bags, recycling, growing plants in their gardens, using their own thermoses in cafes, and avoiding the use of disposable plastic straws. The adoption of such practices, even if they might be seen as somewhat modest, underscores a commitment to sustainability at an individual level and a positive response to the science communicated to them.

Within the realm of personal understanding of sustainability, the reflections of one participant shed light on the interconnectedness of ethical considerations and environmental awareness. As articulated by the speaker, the analogy of an elephant confined within the limited space of a zoo prompts contemplation on the ethical implications of human actions towards animals:

> Like you can't just have an elephant in a zoo. Because the elephant, there's not enough space for a zoo. And you can't have and then illegal to like, hurt like, so. Why is it so it's illegal to kill someone if they're human, but it's not illegal to hunt animals? So, I think they should put like more laws to stop like hunting animals and stuff like that. (S3-Yr5-Sch2)

The student here questions the legality of hunting animals in contrast to the stringent laws protecting human life, highlighting a perceived inconsistency in our societal values. The natural tendency for many young children to feel empathy for animals could be harnessed when teaching about issues of sustainability that go beyond human considerations.

3.2. The Features of the Participant Schools with Regard to the Environmental, Social, Economic, and Educational Dimensions of Sustainability

The distinct advantage of being designated as eco-schools appeared to play a pivotal role in shaping the sustainability initiatives of both schools. However, challenges in implementing efficient recycling practices surfaced, revealing the complexities associated with waste management within the school environment, as elucidated by HT1:

> You know, proper efficient recycling, which, you know, I don't think happens, I think it's quite difficult when you've got a lot of people coming into the school. So, we're trying to recycle, we've only got one recycling bin, but we've got five general wastes. So, when the recycling bin is full, you know, the recycling such that it's tipped into the [waste]; the cleaners are really bad at recycling.

The struggles with recycling infrastructure and custodial practices highlighted the need for enhanced waste management strategies. In addressing environmental concerns, both schools actively promoted sustainable commuting through organised "scoot day[s]" (where students scooted to schools) and participated in national competitions, emphasising the commitment to reducing car usage. HT1 cited an ongoing challenge of sustaining these initiatives, underscoring the balance between belief in their importance and the practical difficulty of maintaining momentum. The integration of sustainable practices, such as growing food for the school's kitchen, demonstrated a commitment to environmentally conscious choices, as voiced by HT1. However, the inherent challenge of sustaining these initiatives over time, as expressed by HT1, emphasised the need for continuous dedication: "I think the strength side that we believe in it, and we want to do things, I think the weakness is keeping it going".

The collaborative approach to sustainability was evident from the teachers' emphasis on developing projects with families and the teachers' focus on recycling practices at School 1. These initiatives showcased a commitment to engaging the broader community and addressing environmental concerns collectively. In essence, while the advantage of being eco-schools laid the groundwork, the challenges highlighted by participants underscored the ongoing dedication required to foster a lasting culture of sustainability within and beyond the school community.

3.3. Perceived Challenges and Opportunities in the Schools as a Consequence of Their Focus on Sustainability

The findings from the discussions with key stakeholders shed light on both the challenges and opportunities in implementing environmental education within the school setting [34]. The identified weaknesses primarily revolve around time constraints, the perceived additional workload for teachers, and budget limitations affecting the school's environmental impact. HT2 candidly acknowledged the struggle to allocate adequate time and space for environmental education, emphasising the need for a fundamental shift in how these initiatives are integrated into the daily operations of the school.

Financial constraints emerge as a significant hurdle, often leading School 2 to opt for the most cost-effective solutions: "We don't have the money to spend on improving our environmental impact. Because we go for that we have to go for the cheapest or most cost-effective solutions and options" (HT2). This compromise, while understandable, is recognised as potentially compromising the integrity of the school's commitment to environmental stewardship; it reduces the effectiveness of the science communication that the teachers provide for their students and makes any sort of transformational learning less likely. The desire for improvement is palpable, yet the practical challenges in allocating resources persist.

However, amidst these challenges, there are several promising opportunities that participants recognise can help propel both schools towards a more sustainable future. HT1 suggested the collection of rainwater, presenting a tangible step towards resource conservation. Additionally, the initiative to grow food on-site, incorporating it into the school's kitchen, stands out as a more effective approach to fostering a deeper connection between students and nature, as stated by T2: "Growing your own food, and then that food is used to cook in the kitchen. And so, not only is that I mean, they still need to buy food, and but what the benefit of that would be, is children then see the direct relationship between planting, growing, cooking and eating". This initiative, if implemented, not only promotes sustainability but also cultivates a mindset where students understand the lifecycle of food from planting to consumption.

The challenges identified include concerns about recycling, alignment with the National Curriculum, and financial limitations. These challenges, when approached strategically, can become stepping stones to positive change. For instance, addressing recycling challenges can lead to improved waste management practices, contributing to a cleaner environment within the school premises. Comparably, the 'walk to school' programme

at School 2, encouraging parents and children to commute sustainably, showcases a commendable effort to instil eco-conscious habits from an early age. As one teacher put it, "Like one thing they do reach the parents like so the walk to school thing is where we encourage like parents and children to walk to school and we track it we so there is that involvement" (T2). This sort of measure can be seen as a proactive step towards integrating environmental education more effectively into the community and the curriculum.

3.4. Information Sources Used in Learning about Sustainability Issues

The participants in the study employed a diverse range of information sources to attempt to deepen their understanding of sustainability issues. Social media was seen as a dynamic platform for science communication, with HT1, T2, and S4 from School 1 highlighting its role in sharing and accessing information within a community context. For adults, communication with other adults served as an invaluable source, providing real-world insights and diverse perspectives (e.g., HT1, T2, and T5). School education, both in terms of climate change curriculum and general sustainability-focused education, remained a cornerstone, according to participants such as HT1, S3-Yr4-Sch1, S3-Yr5-Sch2, and S3-Yr5-Sch1. Television, especially David Attenborough's programmes, played a significant role, engaging HT1, HT2, S3-Yr4-Sch1, and S3-Yr5-Sch1. Participants such as T2 drew on a mix of podcasts, books (including Griscom's work), and newspapers to glean information, highlighting the importance of varied literary and auditory sources. YouTube was a visual medium for learning, attracting such participants as S3-Yr4-Sch1, S2-Yr4-Sch1, S2-Yr4-Sch2, and S5-Yr5-Sch1. T5 actively used YouTube to upload videos on environmental issues. Parents, particularly those with journalistic backgrounds, such as HT2, significantly influenced other participants' knowledge acquisition by talking with them (e.g., S4-Yr4-Sch1, S2-Yr4-Sch1, S3-Yr4-Sch1, S2-Yr4-Sch2, S3-Yr 5-Sch2, and S2-Yr 5-Sch2).

Interactions with friends played a notable role, as seen with participants S2-Yr 4-Sch1 and S2-Yr 5-Sch2, where informal discussions contributed to a collective understanding of environmental concerns. Books emerged as resources for acquiring in-depth knowledge, with participants S4-Yr4-Sch1, S2-Yr4-Sch1, S2-Yr 5-Sch2, and S3-Yr 5-Sch2 turning to them to delve into various aspects of sustainability. Eco-groups within schools, involving participants such as S5-Yr5-Sch1, S2-Yr4-Sch2, and S6-Yr5-Sch1, provided a platform that interviewees suggested offered collaborative learning and hands-on experiences, fostering a sense of shared responsibility toward environmental stewardship, opening the way to the possibility of more transformational learning. Newspapers, a traditional but still relevant source, played a role in helping participants, such as S3-Yr5-Sch1 and HT2, to stay informed about current sustainability issues.

This tapestry of channels indicates the commitment of many of the participants to a deeper understanding of sustainability issues afforded through science communication. By 'science communication', we are referring to the multiplicity of science-related topics that are communicated to members of the public, of all ages, including both teachers and primary school students. The openness of both students and their teachers to this diversity of channels suggests that it is realistic to hope that teachers might help students develop their criticality and, thus, exercise their judgement about the myriad of accounts of sustainability that they come across.

3.5. How Is Environmental and Sustainability Education Enacted and Experienced in Primary Eco-Schools

> "*And I think it's possible to do that. It's a combination of all those little bits, all those schools doing those little bits together that will help to add up to make some big impact*". (HT2)

The teacher and student perspectives on the integration of sustainability topics within educational programmes revealed important insights. Teachers generally expressed that sustainability issues should be embedded within the curriculum, even from Reception [the year before Year 1, where children are aged from four to five] (e.g., ET1). Participants

generally agreed that geography and science are key subjects for integrating sustainability, although concerns about the depth and explicit coverage of the issue of sustainability persisted. Sustainability was also seen to fit into the personal, social, health, and emotional (PSHE) curriculum. While the science curriculum was acknowledged as addressing sustainability, some participants, particularly T3, expressed concerns about its outdated nature and the need for it to change in light of recent technological advancements:

> (. . .) the science curriculum does talk about sustainability, but not as much as probably could. I think it is outdated. I think it needs to change now because you know, technology is changing. (T3)

> I don't think it is in the science curriculum. It should be. (. . .) it needs to be more in-depth in geography. (T4)

Teachers, including T4, highlighted the vague and insufficiently in-depth nature of the geography curriculum, emphasising the importance of explicit coverage on critical issues such as climate change:

> I feel like the geography curriculum is very, at the moment, quite vague. It is not very in-depth as it could be. They say like, I have bits and bobs here and there, but I don't think it's anything explicit. I think there should be a whole thing about climate change. (T4)

Students, according to T3, benefit from open-ended projects, fostering a deeper understanding of sustainability issues. Despite efforts in curriculum design to reflect community values and create responsible citizens, a gap was described in embodying sustainability ideals during curriculum delivery.

In the exploration of sustainability education within primary eco-school curricula, the insights from HT2 provided a foundational perspective. HT2 emphasised the fundamental role of sustainability in the school's vision, rooted in idealism and morality. HT2 articulated four elements—celebrating diversity, being upstanding/activists, living by the school's values, and embracing environmental responsibility and sustainability—that were deemed crucial for enabling children's future success. Sustainability was recognised as integral to the school's purpose.

HT2 further illustrated the practical aspects of sustainability within the school, focusing on issues such as plastic in the oceans and temperature change. The necessity of incorporating sustainability into the curriculum was highlighted, and HT2 acknowledged the challenges of implementing meaningful change, attributing these difficulties to financial constraints and the prioritisation of short-term outcomes. Despite these challenges, HT2 envisioned high-profile initiatives, such as creating a sensory garden and enhancing a local park's environmental sustainability, as opportunities for positive impact:

> I want the geography subject leader and science subject leader to really make sure we showcase those where we are doing our sustainability work. I want, so we've got two projects next year; one is here, which is the sensory garden, and one is down the road. There's a small park called (. . .). And they want to make that park a better environment, both from an environmental perspective, but also from a, yeah, to make it a more sustainable place. And so we're going to be involved in those so I want to try to get the school involved in those things (. . .) because lots of our children will use that park I want us, our children, to be part of that. (. . .) I think we should get involved in because that's our local space, that's where we can have a positive environmental impact.

The commitment to showcasing sustainability efforts and involving students in meaningful projects can be seen to underscore a school-wide dedication to instilling environmental responsibility and sustainability in the school ethos.

When the teacher participants were asked, "In which educational programmes do you think sustainability topics can be more integrated?", they mostly responded with "geography" and "science". However, the National Curriculum, which includes both

geography and science, was criticised for having loose links to sustainability. Teachers, particularly T1, stressed the limitations imposed by the National Curriculum, citing a lack of adequate content on sustainability as a weakness. Environmental problems, notably climate change and pollution, were viewed by participants as consequences of human decisions and actions, highlighting the urgent need for comprehensive sustainability education from an early age.

The findings demonstrated a consensus among participants on the need for a more robust integration of sustainability topics in educational programmes, particularly within the National Curriculum. The teachers expressed a passion for meaningful sustainability lessons, emphasising the importance of nurturing children's well-being in an interconnected world. However, challenges were seen to persist, including perceived inadequacies in the National Curriculum, indicating the necessity for policy changes and a more concerted effort to embed sustainability education into the core of primary education:

> So, what can we do in education? I think first, it is like respecting the child. And I think education needs to slow down in order for that to happen. (T2)

> I believe the problem starts with the National Curriculum. One of strengths about the sustainability in school is the passion and ability of teachers to teach meaningful lesson to the children by encouraging children to maintain or sustain their wellbeing first in an interconnected world. One of the weaknesses is that not enough content is included in the National Curriculum about the sustainability. (T1)

For HT1, the government sees sustainability as mainly the schools' responsibility:

> I would say is that I feel the government's answer to every problem is that schools should teach it. So, no matter what it is, so obesity, schools need to do with its money, sustainability, schools need to do (. . .) Every single problem in society, schools are told that they need to do with it (. . .) which is very overwhelming.

In contrast, HT2 referred to the crucial role of education as follows:

> (. . .) they [students] are to be to celebrate the diversity and inclusivity of all people, races, genders, etc, to be upstanders and activists, to live by the school's values, and to be environmentally responsible and sustainable, and live sustainably. Those are the four things that I think will enable our children to be successful in their futures. So, that sustainability part is fundamental to what I think this school is here for.

These problems can be seen to require different solutions. One of them was a revolutionary approach, as stated by HT2:

> So, it needs people who are actual revolutionaries, I think, whether that be Extinction Rebellion, whether that be people protesting the British Grand Prix yesterday [3 July 2022], whether that be people like Greta Thunberg, but I actually think it's going to be people that might now be considered on the fringe, and radical.

Both schools had eco-groups that included an eco-group leader and students from various years. An eco-committee was selected democratically from Years 3–6 at School 1 and Years 4–6 at School 2, which increased the confidence of those students who applied and were elected. Interviews with the eco-team leaders showed that a large number of students were involved in environmental research, which provided an opportunity for in-depth discussion within the eco-committees and transformational learning.

Teachers' and students' characteristics (experience, age, gender, and field of study) did not seem to make significant differences in terms of their responses. However, students from eco-teams were more knowledgeable and talked more about sustainability issues when compared to their peers. The data gathered from interviews, observations, and the class exercise books indicated that students seemed to have enthusiasm and were aware of their responsibilities as 'powerful agents of change' with regard to sustainability and

climate change issues. From a science communication perspective, it was evident that the students had learned from their schools, families, and the media about climate change.

In-class observations and interviews showed that both schools made connections with environmental issues in some curriculum areas, particularly geography, science, and art. Overall, School 2 seemed to have a better dedication to environmental education with curriculum link evidence (e.g., a tree-planting project) provided by the eco-team leader. As a final point, the teachers in both schools expressed interest in expanding their knowledge as well as their students' understanding of sustainability and climate change. In this context, the teacher participants from both schools stated their interest in participating in in-service training programmes.

4. Discussion

The level of knowledge and meaningful discussions taking place among teachers, headteachers, and the fourth and fifth graders in these schools on topics related to climate change and sustainability suggests how welcome these topics are to participants and the possible effectiveness of the teaching and engagement strategies to enable transformational learning. The proactive approach to education can be seen not only to enrich the learning environment but also to equip students with what we perceive to be valuable insights into crucial global issues.

However, the results indicated that there is a tension between different understandings of sustainability. This tension often reflects the tension between maintaining existing socio-economic and political structures and embracing more transformative, holistic approaches to sustainability. Furthermore, an interdisciplinary approach to the topic can be understood to be one of the keys to successful, indeed, transformational, learning, that is, treating it not as a separate subject to be taught on its own, such as 'environmental education' or only as part of the natural sciences, but rather as an integral part of every school subject's curriculum and study plan.

Regarding school education, the following skills and characteristics of ESD learning methods outlined in [35] were considered: student-centred teaching methods; future-oriented thinking; higher-order thinking skills; critical thinking; interdisciplinarity; and linking local and global issues. The Rio+20 Conference reaffirmed that universal access to primary education and quality education at all levels is "essential for achieving sustainable development" (p. 1). The key issue here is that the nature of sustainability issues seems to raise pedagogical issues in changing subject content and requires transformative approaches; this need can cause difficulties in schools that are subject to all sorts of practical constraints.

While challenges regarding time, National Curriculum requirements, and budget constraints persist, the identified opportunities offer a roadmap for schools to enhance their environmental education initiatives. By strategically addressing challenges and capitalising on opportunities, such as rainwater collection, sustainable food practices, travelling to and from school, and community involvement, a school can pave the way for a more environmentally conscious and educationally enriching environment. The commitment to improvement, as voiced by HT2, provides a foundation for a sustainable and impactful educational journey.

The findings underscore a consensus among participants on the need for a more robust integration of sustainability topics in educational programmes, particularly within the National Curriculum. This would help provide more effective science communication and increase the likelihood of sustainability education, resulting in transformative learning. Considering our observations and interview results, we have found gaps in the current sustainable education curricula in England. Specifically, a parallel result to [36], where teachers express a passion for meaningful sustainability lessons, emphasising the importance of nurturing children's well-being in an interconnected world. However, they frequently lack the confidence, abilities, understanding, and support to do so. In addition, teachers face some challenges, including perceived inadequacies in the official curriculum,

indicating the need for policy changes and a more concerted effort to embed sustainability education into the core of primary education.

Most of the teacher participants emphasised that the responsibility to deal with sustainability issues was the government's but that the government did not seem to take the communication of sustainability, both in formal and informal ways, seriously. In a school setting, we would expect that a government should, at the minimum, have a national curriculum in which space is given for learners to develop their understanding of issues to do with sustainability in its various forms—e.g., biodiversity loss, anthropogenic climate change, soil erosion, and pressures on water supplies. Ideally, such understanding should lead to changes in behaviour in individuals at the school level and more systemically. In parallel with the argument in [37], what is most needed is "concrete support that is close to teaching and the schools' objectives" (p. 1). Such support is likely to be needed if more than a small proportion of schools are able to engage in teaching that enables effective transformation for students. Perhaps the most important manifestations of that support would be (a) a requirement for sustainability to be embedded across the curriculum in primary schools and not just in geography and science, (b) a lessening of other demands on teachers' time, and (c) the provision of high-quality professional development for teachers, a point to which we return below.

Participants reported that they obtained their information about climate change and sustainability from a range of sources, including podcasts, books, newspapers, and YouTube, underlining the varied media drawn on by the 'learning community' as a whole. The influence of parents on students' knowledge acquisition is noteworthy, showcasing the more general impact of familial environments. Interactions with friends, informal discussions, and eco-groups within schools all contribute to a collective understanding of environmental issues, emphasising the significance of social dynamics in knowledge exchange, as also discussed by Illeris [38]. Community of practice theories of learning tend to suggest that learning does not have to reside in one individual. It can reside in the community as a whole; likewise, our data suggest that the community has a wide range of resources, but each individual does not (or not necessarily). Books (participants did not specify the type of the book, whether academic or not) remain resources for acquiring in-depth knowledge, with several participants turning to these to explore various facets of sustainability. From a science communication perspective, one can see the one-way uptake of scientific knowledge about sustainability that study participants combined with dialogue about it. The formation of a community of practice brings along with it a shift in participants' sense of identity, opening up the possibility of more transformative learning.

Eco-groups within schools emerged as a distinctive platform that makes a difference in collaborative learning and hands-on experiences, with evidence that they are fostering a sense of shared responsibility towards environmental stewardship. Those committee members would then be able to share their findings and views more widely with their classmates. These practices, through their adoption of two-way conversations and active participation and openness to the possibility of change, are also important in terms of being consistent with the principles and processes of effective science communication and deep (transformative) learning.

Traditional sources, such as newspapers, continue to play an important role for a number of our study's participants, ensuring that they stay informed about current sustainability issues, though, of course, as with any source of 'information', newspapers have, at the very least, their own perspectives on sustainability and climate change issues (contrast, for example, the more eco-friendly [39] newspapers with the more climate change sceptic newspapers [40]). An optimistic interpretation is that the wide array of media used and accepted reflects the commitment of the community of participants to a well-rounded and more extensive understanding of sustainability, which is consistent with the recognition of the multifaceted nature of contemporary knowledge acquisition in this critical field.

While the study generated rich data and enabled us, through our use of the lenses of science communication and transformative learning, to produce new insights into the

potential of sustainability education at the primary school level, it is limited to the research undertaken in two primary state eco-schools, which jointly constitute a single case, with a specific set of individuals in London. Therefore, the findings may not be applicable to other schools in London or beyond. Nevertheless, we find little in our data to suggest that these schools are exceptional. We suspect that the lessons learned here, specifically the factors that help or hinder effective student learning about sustainability, may apply more widely.

A more significant limitation is likely to be that the data for the study—the opinions of teachers, headteachers, eco-team leaders, and fourth- and fifth-grade students, as well as the observations made by the first author—were gathered over a period of 14 weeks. The study may offer insights into the current state of sustainability and climate change education in the two schools, but it lacks a longitudinal perspective, hindering the ability to track changes over time and to understand trends. A longitudinal study—using interviews and observations to ascertain whether major shifts in thoughts and practices have taken place—would help determine the extent to which transformative learning can, indeed, result from effective science communication in a school setting. Such a study, of course, needs to not be restricted to the schools that participated in this study.

5. Conclusions

This research examined participants' perceptions of sustainability and climate change in two eco-schools in England for primary school children (aged 5–11 years). Our case study made use of a range of data collection methods, principally interviews and observations. Students and teachers alike were aware of the environmental dimensions of sustainability, such as climate change and the overuse of natural sources. Nevertheless, the integration of sustainability into the curriculum was limited and problematic. We draw on theories of science communication and transformative learning to help us understand the reasons for this. Schools are like any institution in that there can be significant barriers to change. In particular, schools are under great pressure, especially in terms of time demands and the need to meet external targets, such as doing well in official inspections. One of our conclusions is, therefore, that schools are no different to other institutional settings when it comes to dealing with the challenges of integrating sustainability into daily practice. Nevertheless, both of our schools exhibit considerable potential for transformative learning despite the political contexts in which they operate, at least in part because of the affordances of the eco-school initiative in which they are participating.

Future research could complement this research by looking at primary schools that do not have a particular focus on sustainability and by looking at the situation in secondary (11–16 or 11–18 years) schools. It would also be valuable to gather data on the perceptions of parents and policymakers. These sorts of insights could confirm the extent to which key conclusions—e.g., about the challenges of sustaining sustainability activities—are widely experienced. This could highlight where policy changes or better resourcing should be committed. The study might be also expanded by studying a large number of schools from different regions or educational systems. A comparative analysis would help identify common trends, as well as variations, in the perceptions and experiences of stakeholders. Future research might also focus on longitudinal perspectives to explore insights into the dynamics of state schools in London, or elsewhere, and the effectiveness of policy implementation.

Finally, this study indicates a need for high-quality teacher professional development courses on sustainability issues to be more widely available. If and when such courses are developed, there will be a need for them to be evaluated not only to determine their effectiveness, e.g., in fostering transformative learning, but so that future iterations of such courses can be improved.

Author Contributions: Conceptualisation, S.G.B. and M.J.R.; methodology, S.G.B. and M.J.R.; formal analysis, S.G.B.; investigation, S.G.B.; resources, S.G.B. and M.J.R.; data curation, S.G.B.; writing—original draft preparation, S.G.B.; writing—review and editing, S.G.B. and M.J.R.; visualization, S.G.B.; supervision, M.J.R.; project administration, M.J.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was approved by the Research Ethics Committee at University College London (Z6364106/2022/04/05).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the participants to publish this paper.

Data Availability Statement: Reasonable requests for access to the data gathered in this study may be made to the first author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Teacher Interview Protocol

Section One

If you are happy to let me know, in what year were you born?
Gender:
Your most recent degree (e.g., undergraduate, Masters, PhD):
Teaching experience (in years):
How would you rate your personal understanding of sustainability?

Very good	Good	Reasonable	Little	None
☐	☐	☐	☐	☐

Section Two

1. What do you think are the biggest environmental problems facing the World today?
2. What might be done to solve this/these problem/s? Who might be responsible for dealing with these problems?
    - 2.1. What might schools do?
    - 2.2. What might teachers do?
    - 2.3. What might families do?
    - 2.4. What might the government do?
3. Can you please try to explain to me what you understand by 'sustainability'?
    - 3.1. Can you please name as many sustainability issues as you can?
    - 3.2. Where have you learnt about sustainability? (e.g., formal/informal education, media, etc.)
4. Do please tell me about your understanding of what the National Curriculum expects with regards to sustainability education and climate change education.
5. UNESCO says: "Learning must prepare students and learners of all ages to find solutions for the challenges of today and the future". Do you think the topic of sustainability should have a place in education? How?
    - 5.1. Curriculum and instruction
    - 5.2. School facilities, including physical conditions
    - 5.3. School community (e.g., teachers, students, school administration, staff, parents)
6. Can you please try to explain to me what you understand by 'climate change'?
    - 6.1. Where have you learnt about climate change? (e.g., formal/informal education, media, etc.)
7. Please tell me how you teach about climate change and sustainability issues.
    - 7.1. Aims, goals, objectives
    - 7.2. Content organisation
    - 7.3. Implementation
    - 7.4. Assessment

8. What do you think about the strengths and weaknesses concerning the implementation of sustainability in your school?
9. Would you like to participate in a sustainability training programme? If yes, what would you like to learn about sustainability in this training?
10. Is there anything you would like to add that might contribute to our research? Thank you for your participation.

References

1. Brundtland, G.H. Global change and our common future. *Environ. Sci. Policy Sustain. Dev.* **1989**, *31*, 16–43. [CrossRef]
2. UNCED, Global 21 Rio Declaration on Environment and Development. 1992. Available online: https://sdgs.un.org/sites/default/files/publications/Agenda21.pdf (accessed on 10 March 2024).
3. United Nations Decade of Education for Sustainable Development (2005–2014). 2005. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000148654 (accessed on 10 March 2024).
4. UNESCO Global Action Programme on Education for Sustainable Development. 2016. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000246270 (accessed on 10 March 2024).
5. Incheon Declaration and Framework for Action for the Implementation of Sustainable Development Goal 4. 2015. Available online: https://www.unesco.at/fileadmin/user_upload/Education_2030_Incheon_Declaration_and_Framework_for_Action_for_the_implementation_of_Sustainable_Development_Goal_4_.pdf (accessed on 10 March 2024).
6. Brundiers, K.; Wiek, A.; Redman, C.L. Real-world learning opportunities in sustainability: From classroom into the real world. *Int. J. Sustain. High. Educ.* **2010**, *11*, 308–324. [CrossRef]
7. Draft International Implementation Scheme for the United Nations Decade of Education for Sustainable Development. 2005. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000139023 (accessed on 10 March 2024).
8. Suarez-Orozco, M. (Ed.) *Learning in the Global Era: International Perspectives on Globalization and Education*, 1st ed.; University of California Press: Berkeley, CA, USA, 2007.
9. Summers, M.; Kruger, C.; Childs, A.; Mant, J. Primary School Teachers' Understanding of Environmental Issues: An interview study. *Environ. Educ. Res.* **2000**, *6*, 293–312. [CrossRef]
10. Wals, A.E.; Corcoran, P.B. *Learning for Sustainability in Times of accelerating Change*; Wageningen Academic Publishers: Wageningen, The Netherlands, 2012.
11. Wamsler, C.; Brossmann, J.; Hendersson, H.; Kristjansdottir, R.; McDonald, C.; Scarampi, P. Mindfulness in sustainability science, practice, and teaching. *Sustain. Sci.* **2018**, *13*, 143–162. [CrossRef] [PubMed]
12. Rieckmann, M. Learning to Transform the World: Key Competencies in Education for Sustainable Development. 2018. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000261802 (accessed on 10 March 2024).
13. Worries about Climate Change, Great Britain: September to October 2022. 2022. Available online: https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/worriesaboutclimatechangegreatbritain/septembertooctober2022 (accessed on 10 March 2024).
14. Graham, H.; De Bell, S. The representation of future generations in newspaper coverage of climate change: A study of the UK press. *Child. Soc.* **2021**, *35*, 465–480. [CrossRef]
15. Sustainability and Climate Change: A Strategy for the Education and Children's Services Systems. 2023. Available online: https://www.gov.uk/government/publications/sustainability-and-climate-change-strategy/sustainability-and-climate-change-a-strategy-for-the-education-and-childrens-services-systems (accessed on 10 March 2024).
16. The National Curriculum in England. Key Stages 1 and 2 Framework Document. Department of Education, Ed.; 2013. Available online: https://assets.publishing.service.gov.uk/media/5a81a9abe5274a2e8ab55319/PRIMARY_national_curriculum.pdf (accessed on 10 March 2024).
17. Cash, D.W.; Clark, W.C.; Alcock, F.; Dickson, N.M.; Eckley, N.; Guston, D.H.; Jäger, J.; Mitchell, R.B. Knowledge systems for sustainable development. *Proc. Natl. Acad. Sci. USA* **2003**, *100*, 8086–8091. [CrossRef] [PubMed]
18. Mezirow, J. Understanding transformation theory. *Adult Educ. Q.* **1994**, *44*, 222–232. [CrossRef]
19. Reiss, M. Science education at a time of existential risk. *Sch. Sci. Rev. Depth* **2023**, *105*, 5–10.
20. Meadows, D.H.; Meadows, D.L.; Randers, J.; Behrens, W.W. The limits to growth. In *Green Planet Blues*; Routledge: London, UK, 2018; pp. 25–29.
21. Burns, T.W.; O'Connor, D.J.; Stocklmayer, S.M. Science communication: A contemporary definition. *Public Underst. Sci.* **2003**, *12*, 183–202. [CrossRef]
22. Gelmez Burakgazi, S. Science communication in Turkey, in light of critical events, political documents, reports, and research. *Selcuk Commun.* **2017**, *10*, 232–261.
23. Irwin, A. Risk, science and public communication: Third-order thinking about scientific culture. In *Handbook of Public Communication of Science and Technology*; Routledge: London, UK, 2008; pp. 213–226.
24. Goldstein, C.M.; Murray, E.J.; Beard, J.; Schnoes, A.M.; Wang, M.L. Science Communication in the Age of Misinformation. *Ann. Behav. Med.* **2021**, *54*, 985–990. [CrossRef] [PubMed]
25. Davies, S.R. Science Communication at a Time of Crisis: Emergency, Democracy, and Persuasion. *Sustainability* **2022**, *14*, 5103. [CrossRef]

26. Cormick, C. We Need to Do Better: Five Notable Failings in Science Communication. *Sustainability* **2022**, *14*, 8393. [CrossRef]
27. Merriam, S.B. *Qualitative Research and Case Study Applications in Education. Revised and Expanded from "Case Study Research in Education"*; Jossey-Bass Publishers: San Francisco, CA, USA, 1998.
28. Vasileiou, K.; Barnett, J.; Thorpe, S.; Young, T. Characterising and justifying sample size sufficiency in interview-based studies: Systematic analysis of qualitative health research over a 15-year period. *BMC Med. Res. Methodol.* **2018**, *18*, 148. [CrossRef] [PubMed]
29. Vindrola-Padros, C. *Rapid Ethnographies: A Practical Guide*; Cambridge University Press: Cambridge, UK, 2021.
30. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
31. Marshall, C.; Rossman, G.B. *Designing Qualitative Research*; Sage publications: Thousand Oaks, CA, USA, 2014.
32. Lincoln, Y.S.; Guba, E.G. *Naturalistic Inquiry*; Sage Publications: Thousand Oaks, CA, USA, 1985.
33. Griscom, J.H. *The Uses and Abuses of Air: Showing Its Influence in Sustaining Life, and Producing Disease: With Remarks on the Ventilation of Houses, and the Best Methods of Securing a Pure and Wholesome Atmosphere inside of Dwellings, Churches, Courtrooms, Workshops, and Buildings of All Kinds*; Redfield: Venice, Italy, 1854.
34. Walshe, N.; Moula, Z.; Lee, E. Eco-Capabilities as a Pathway to Wellbeing and Sustainability. *Sustainability* **2022**, *14*, 3582. [CrossRef]
35. Scoullos, M. *Education for Sustainable Development in biosphere Reserves and other Designated Areas: A Resource Book for Educators in South-Eastern Europe and the Mediterranean*; United Nations Educational, Scientific and Cultural Organisation (UNESCO): New York, NY, USA, 2013.
36. Trott, C.D. Children's constructive climate change engagement: Empowering awareness, agency, and action. *Environ. Educ. Res.* **2020**, *26*, 532–554. [CrossRef]
37. Waltner, E.M.; Scharenberg, K.; Hörsch, C.; Rieß, W. What teachers think and know about education for sustainable development and how they implement it in class. *Sustainability* **2020**, *12*, 1690. [CrossRef]
38. Kakouris, A.; Morselli, D.; Pittaway, L. *Educational theory Driven Teaching in Entrepreneurship*; Elsevier: Amsterdam, The Netherlands, 2023; p. 100814.
39. Crace, J. The Climate Crisis? We've Been Investigating It for More than 100 Years, in Guardian. 2022. Available online: https://www.theguardian.com/environment/2022/oct/02/climate-crisis-guardian-investigating-pledge-decades-1890 (accessed on 10 March 2024).
40. Ward, B. The Daily Mail Is still Promoting Climate Change Denial, in Daily Mail. 2021. Available online: https://www.lse.ac.uk/granthaminstitute/news/daily-mail-still-not-taking-climate-change-seriously/ (accessed on 10 March 2024).