

Education in the climate emergency: school sustainability practices, climate imaginaries, and teaching hope



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Abstract

The Intergovernmental Panel on Climate Change has reported with very high confidence that human activity is changing the climate, that climate change has severe impacts for human and natural systems, and that we have a limited window to dramatically reduce greenhouse gas emissions and limit global warming to 1.5 °C. Our future is being shaped by this crisis and our collective responses to mitigate and adapt to it. This article-based thesis presents interdisciplinary research on the response of secondary schools in England to climate change. The chapters first introduce a doctoral journey over 3.5 years, including adaptations in response to COVID-19. They then present a combined literature review, weave together the three academic articles, and end by exploring the contributions of this research and sharing future plans. The first paper (Chapter 3) was based on a large number of semi-structured interviews and focus group conversations with different school stakeholders at both state and independent schools. Theories of social practice and practice architectures were used to explore bundles of practices and the arrangements that support them related to sustainability, especially in terms of semantic (sayings), material (doings) and social (relatings) dimensions. The article, currently under peer review by the journal *Energy Research and Social Science*, argued for expanding whole-school approaches to sustainability to incorporate insights from practice architectures. The second paper (Chapter 4) involved data collection through a questionnaire distributed to Sixth Form students and teachers, primarily comprising measures of action competence and climate hope that were previously developed and validated by other researchers. Quantitative analysis of this data revealed the relationship between teacher practices and student reported hope, and compared responses based on students from independent versus state schools and students that identified as female versus male. This article was published in the journal *Environmental Education Research*. The third paper (Chapter 5) used the creative, participatory method of speculative digital storytelling, in which 16-18-year-olds in the UK and Ireland participated in workshops to produce a short 'letter from the future' in a video format. Through reflexive thematic and narrative analysis, themes related to the scripts and visuals were identified, as well as different narratives of climate futures. This article was published in the journal *Children's Geographies*. The discussion (Chapter 6) outlines three threads that weave together the research – education, futures, storytelling – and offers a series of methodological, theoretical and empirical contributions, including speculative digital storytelling, practice-informed whole-school sustainability, and hope-based pedagogies in climate education.

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List of Abbreviations

BERA		British Educational Research Association
CCE		Climate Change Education
COP		Conference of the Parties
COP26		26th Conference of the Parties to the UNFCCC, held in Glasgow, UK, 2021
DfE		UK Department for Education
IPCC		Intergovernmental Panel on Climate Change
NAEE		National Association for Environmental Education
SDG		Sustainable Development Goal
UNESCO		United Nations Education, Scientific and Cultural Organization
UNFCCC		United Nations Framework Convention on Climate Change

1

Introduction

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In January 2023, the Met Office confirmed that the average temperature in the UK over the course of 2022 was 10.03 °C (McCarthy et al. 2023). In a temperature record that goes back to 1884, this was the highest annual average and first time the figure was above 10 °C. Above average temperatures were experienced for 70% of the days in 2022 (compared to a 1991-2020 baseline). On 19 July, the highest ever recorded temperature in Britain – 40.3 °C – was captured by a weather station in Coningsby, Lincolnshire, marking the first day a maximum temperature reached above 40 °C in the UK (Kendon 2022). A year of climate milestones recorded with the cold precision of thermometers.

As a researcher, and having worked in digital communication for environmental charities, I have a professional interest in this news. Or at least, that is how I justify the doom-scrolling of the press release, media coverage and my social media feed. News that shocks but does not surprise is all too common these days, and climate change is no exception. The ten hottest years in the UK have been recorded in

the past two decades, and the science of climate attribution confirms that human activity is driving extreme weather. For example, Met Office simulations indicate that an annual average of 10 °C might only have occurred once in 500 years naturally, but in the future most years will be at or above this temperature (Christidis et al. 2023). This year's record-breaking temperature is tomorrow's new normal.

I notice the time and leap up from my desk; I'm late for the school pick-up. Walking back with the twins, Bea is buzzing with excitement, having been elected as the Eco Rep for her year. She performs her speech on the pavement, including the silly 'mic drop' bits she left out when in front of the class. At nine years old, her platform mixes the personal and the social: her brother was in Eco Club last term, so it is her turn, and she hopes a friend will be the other Eco Rep; she loves animals and is willing to do her part to turn off lights and clean up litter. For her, care for the natural world is natural, and environmental concerns don't weigh on her the same way they affect her parents. I worry about how long this bubble – sheltered from an uncertain, precarious future – can last.

Over the past 3.5 years, I have been thinking about school sustainability and climate education – or, put another way, education in the climate emergency – both as a researcher and as a parent. At this moment in time, as we experience the heat waves and extreme weather predicted by climate scientists, how are our education systems responding? How are schools preparing young people for a future shaped by climate change and our collective response to the climate crisis? These are the central questions explored in the pages that follow.

Over the course of my doctoral studies, this research evolved into three distinct academic papers, each utilising different methods of data collection and analysis, and responding to different academic disciplines and theories. The three core research question related to these papers can be summarised as:

1. What are the social practices – and practice architectures (semantic, material, relational) – of sustainability in secondary schools?

2. How do sixth form students and teachers view the future and climate change in terms of constructive hope and action competence, and how might this translate into a model of emotionally-mediated education for climate action?
3. How do young people imagine futures shaped by climate change and our collective response to the climate crisis, and what is the impact on young people of creatively engaging with the future?

This thesis report weaves together these academic papers. In this introduction, I share the motivation for undertaking this study, and the context and methods of my research, including how they evolved in response to the COVID-19 pandemic. A literature review follows, which synthesises the interdisciplinary foundations of this research from the fields of environmental education, children's geographies, and energy and sustainability research. Each paper – two of which have been published and a third which is currently under peer review – is briefly introduced. After the papers, a discussion chapter is comprised of reflections on the findings of each paper, contributions of this research, and future directions. I include additional related activities undertaken over the course of my doctoral studies and a full list of the videos created through the speculative digital storytelling process as appendices.

1.1 A life of warming

When I give presentations about climate change to different audiences, I often use the climate stripes developed by Ed Hawkins at the University of Reading as a visual aid (Hawkins n.d.). Using a range of shades of blue and red to illustrate annual average temperatures below and above a baseline (calculated from 1971 to 2000), these data visualisations clearly demonstrate an undeniable trend of warming. The Radcliffe Meteorological Station at the University of Oxford is the site of one of the longest running temperature records in the world, which can be seen in climate stripes from 1814 to 2021 (Figure 1.1).

I have personally experienced over 45 years of warming. I was born in 1977 in Memphis, Tennessee, when atmospheric carbon dioxide was at 333 parts per

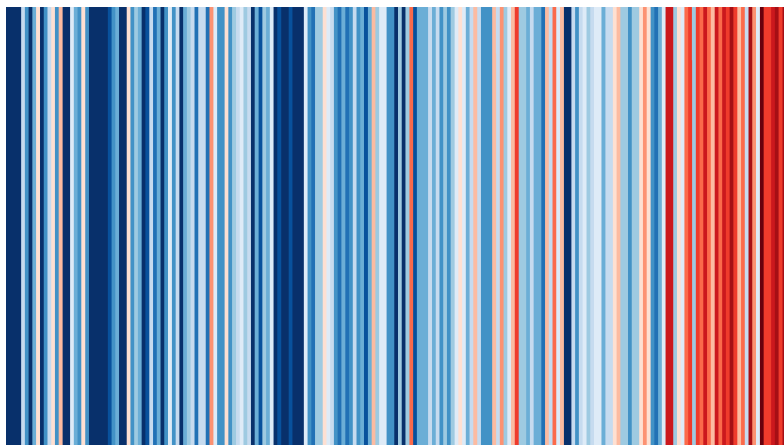


Figure 1.1: Climate stripes for Oxford, United Kingdom, from 1814 to 2021 (Ed Hawkins, University of Reading, CC BY 4.0)

million in the atmosphere and average global temperatures were 0.10 degrees Celsius higher than the average from 1961 to 1990¹. That same year, an international conference convened leaders in education and the environment to discuss the goals, objectives and guiding principles for the new field of environmental education. I moved to Anchorage, Alaska in 1992 – the year the United Nations Framework Convention on Climate Change (UNFCCC) began – where I started high school and first experienced wilderness (359 ppm CO₂, 0.12 °C warming). By 2003, I had completed an undergraduate degree in environmental studies, a master’s degree in environmental science, and started a company to help environmental organisations communicate about issues like climate change (378 ppm CO₂, 0.54 °C warming). In the milestones of life that followed, atmospheric carbon dioxide and global temperatures marched steadily upwards: married in 2007 (381 ppm CO₂, 0.59 °C warming), first child born in 2009 (386.05 ppm CO₂, 0.60 °C warming), immigrated to the UK in 2012 (396 ppm CO₂, 0.58 °C warming), naturalised as a British citizen in 2018 (409 ppm CO₂, 0.76 °C warming).

As of January 2023, the atmospheric carbon dioxide measured at the Mauna Loa observatory in Hawaii had reached 419 ppm CO₂, and the Met Office HadCRUT5

¹The values for atmospheric carbon dioxide come from the monthly record of the Mauna Loa observatory of the Scripps Institute of Oceanography, the source of the Keeling Curve (Keeling et al. 2001). The values for global historical surface temperature anomalies (relative to a 1961-1990 reference period) come from the UK Met Office HadCRUT5 model (Morice et al. 2021).

model reported global average temperatures of 0.80 °C above the 1961-1990 baseline (compared to pre-industrial levels, global temperatures have increased by 1.16 °C). This year the Intergovernmental Panel on Climate Change – an international collaboration of scientists convened by the United Nations Environment Programme and World Meteorological Society – turns 36, having published six comprehensive assessments of climate science, impacts and solutions, as well as a number of special thematic and methodological reports. In 2023 the UNFCCC – the international treaty facilitating political and economic cooperation on climate change mitigation and adaptation – turns 31, and in that time the conference of parties (COP) to the convention has met 27 times. Over three decades of scientific collaboration and political agreements, and yet greenhouse gas emissions and global temperatures are still rising.

1.2 A decade of consequence

The motivations for this research can be traced back to the IPCC’s 2018 special report on global warming of 1.5 °C (IPCC 2018). COP21 of the UNFCCC resulted in the Paris Agreement, a framework for international cooperation with the primary objective of:

Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change (United Nations 2015).

Based on current trends, this 1.5°C increase in global average temperature will be reached at some point between 2030 and the middle of this century. The IPCC special report thoroughly investigated what it would take to limit warming to the higher ambition target:

In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO₂ emissions decline by about 45% from 2010 levels by 2030 (40–60% interquartile range), reaching net zero around 2050 (2045–2055 interquartile range) (IPCC 2018, 12).



Figure 1.2: Protesters occupy the office of Nancy Pelosi, leader of the US House of Representatives, Washington, DC, 13 November 2018 – a number of t-shirts are printed with ‘12 years’ and a partially obscured banner reads ‘We have 12 years, what’s your plan?’ (Sunrise Movement)

It was this takeaway – the importance of cutting emissions almost in half by the end of this decade – that was used as a rallying cry by young climate activists like the Sunrise Movement: we have ‘12 years’ left to act on climate change (Figure 1.2). Having worked on environmental issues for my whole career, the IPCC report lit a new fire for me, mid-career and mid-life, and led to me starting these doctoral studies to further explore questions based on my previous 16 years of environmental communication work, including close collaborations with environmental education organisations.

I wasn’t the only person jolted into some form of action by new awareness of the urgency of our planetary situation: in 2019, Greta Thunberg’s school strikes expanded into the global Fridays for Future movement, Extinction Rebellion protests occupied roads and bridges in London, and the UK Parliament declared a climate emergency and updated the Climate Change Act to enshrine in law the target of net-zero carbon emissions by 2050.

The UK Climate Change Committee, the independent scientific body set up by the Climate Change Act to advise the government, has outlined how net-zero greenhouse gas emissions can be achieved. An important element of this report is the recognition that net-zero will require both technical changes – for example, decarbonising energy supply and electrifying heat and transport – and societal and behavioural changes, with societal/behavioural change accounting for 9% of the necessary emissions reductions, and an additional 53% of emission reductions from the combination of low carbon technologies and societal/behavioural change (Climate Change Committee 2019). Having studied social ecology and worked in environmental communication, I was drawn to this societal and behavioural aspect of responding to climate change as I contemplated the subject of my research during this decade of consequence.

1.3 A year turned upside down

As my research plans developed in late 2019 and early 2020, I grew particularly interested in the important role of schools in helping the UK reach net-zero. The 2016 Building Energy Efficiency Survey, a government review of non-domestic building stock in England and Wales, reported that the education sector is comprised of 47,500 premises with a total floor area of 80 million m² and annual energy consumption of 15,020 GWh (BEIS 2016). With 40% of schools constructed between 1940 and 1985, the survey's abatement model found that energy consumption in the education sector could be reduced by 45% with a £2.1 billion capital investment. At the same time, both the education system and the norms and value systems it can influence have been recognised as points of leverage in reaching social tipping points, where interventions such as climate education have the disruptive, transformative potential to lead to rapid decarbonisation (Otto et al. 2020).

In March 2020 I submitted my transfer of status report, proposing mixed methods research at secondary schools in England (Figure 1.3). By the end of the month, the UK government implemented a national lockdown in response to the COVID-19 pandemic. The disruptions caused by coronavirus directly impacted my research,

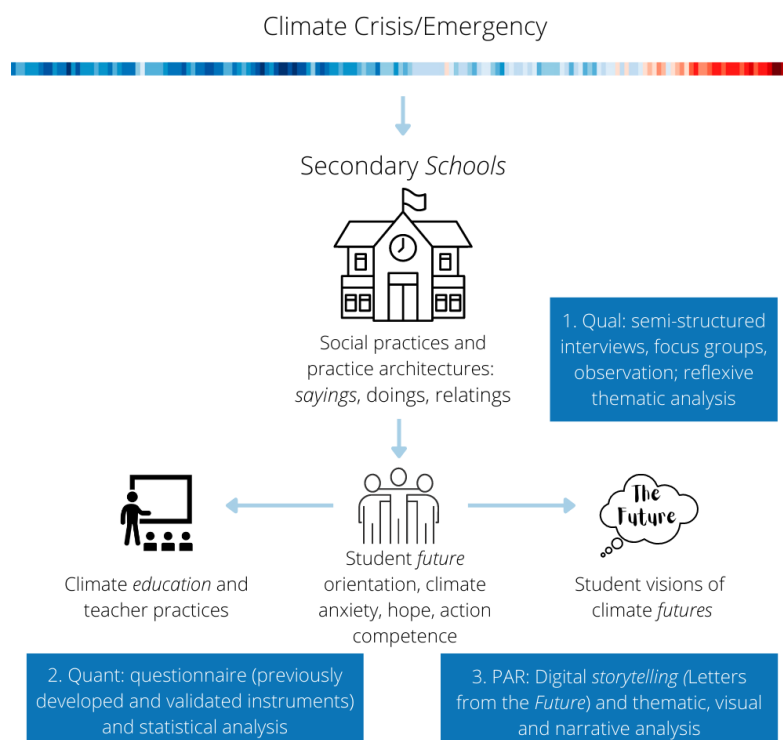


Figure 1.3: Summary diagram of the research methods utilised in this thesis (*italicised words are themes that cut across the three papers*)

forcing me to adapt my data collection methods. For example, I had planned to begin site visits to schools in the autumn term of the 2020-2021 school year. While schools reopened in September, after instituting school closures and home learning for much of the previous spring, secondary schools in England were navigating new school policies related to regular testing and keeping students in separate bubbles. As a result, I was unable to visit schools or conduct the initial round of stakeholder interviews and student focus groups in-person, and instead used the video conferencing software Zoom, with interviews starting in January 2021.

The digital storytelling aspect of my research was similarly impacted. I conducted an initial two-day, in-person workshop over the 2020 October half-term school break at the Oxford University Museum of Natural History (Figure 1.4). We wore masks and carefully followed the circulation patterns of the museum, while engaging with positive and negative future scenarios and participatory filmmaking. A few days later, a second national lockdown was announced and school closures reinstituted.



Figure 1.4: Participant in digital storytelling workshop, Oxford University Museum of Natural History, October 2020

I adapted the digital storytelling workshop to also work remotely through a series of three two-hour sessions, scheduled over three weeks, conducted with groups of Sixth Form students via Zoom, Microsoft Teams, and Google Meet.

The questionnaire aspect of my research also reflects a COVID-19 pivot. Initially developed to gather structured information from workshop participants, in the hopes that response rates would allow for pre- and post-testing (which, unfortunately, wasn't the case), I realised that the questionnaire could be easily distributed as an online survey to the schools where I was conducting interviews and focus groups. This also allowed me to incorporate quantitative analysis into my research and develop coding skills in Python, which led to opportunities to participate in the Data Stories group at the Alan Turing Institute.

By the summer term of 2021, many schools had opened up again to visitors, and I was able to conduct site visits, as well as in-person interviews, focus groups, and digital storytelling workshops. As a result of the pandemic, my data collection was delayed and I was forced to adapt my plans, while also having increased caring and home-schooling responsibilities as a result of school closures.

1.4 Anthropocentric in the Anthropocene

As I began this project, the field of research and practice that I was most familiar with was environmental education. I briefly served as an environmental educator in the Urban Resources Initiative's *Open Spaces as Learning Places* programme, and my master's research involved participatory video production as a form of environmental education with middle school students, in both cases in New Haven, Connecticut. In the professional work that followed, I served as a media and technical consultant to the North American Association for Environmental Education, developing an online community, producing learning modules about research and evaluation, and supporting the Global Environmental Education Partnership.

Environmental education – and the related fields of sustainability and climate education – thus felt like my intellectual home and the starting point for me to engage theoretically with the fundamental questions of this research. Going back to the first Intergovernmental Conference on Environmental Education in 1977, which resulted in the Tbilisi Declaration, the field of environmental education has been concerned with harnessing education to promote behavioural and social change (UNEP 1977). Many of the seminal articles in this field relate to models of behaviour change, with Hungerford and Volk (1990) noting over three decades ago that knowledge alone does not lead to changes in behaviour, and proposing a series of ownership and empowerment variables that influence behaviour change. Similarly, Kollmuss and Agyeman (2002) proposed a new model of pro-environment behaviour (Figure 1.5) incorporating internal and external factors and barriers to change (see also Heimlich and Ardoin 2008, Marcinkowski and Reid 2019).

For my doctoral studies, I have been based in a team of mostly social scientists engaging with questions of energy systems and transformations. As I re-engaged with the environmental education literature, it became clear that environmental education was centring individuals and their choices. The complicated models of psychosocial factors seen from the perspective of the individual began to resemble the geocentric models of the solar system from before Copernican heliocentrism (Figure 1.6). When the Earth was seen as the centre of the universe, the planets

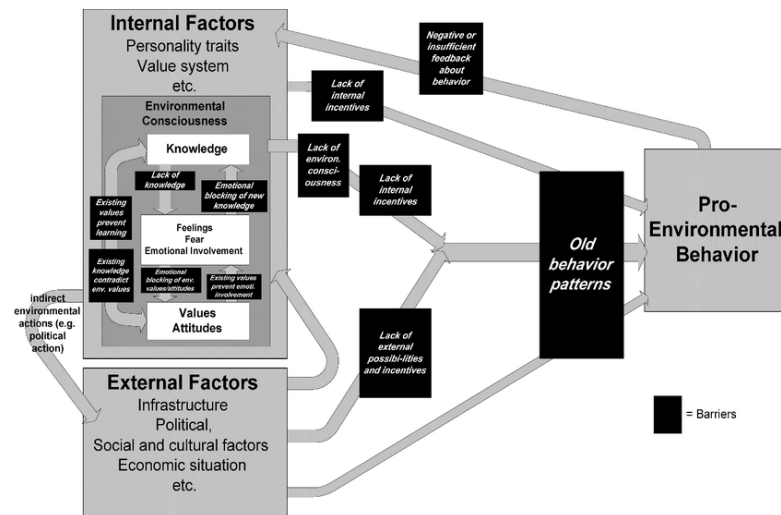


Figure 1.5: The Kollmuss-Agyeman model of pro-environmental behaviour (2002) – the most cited and read (online) article in the journal *Environmental Education Research*

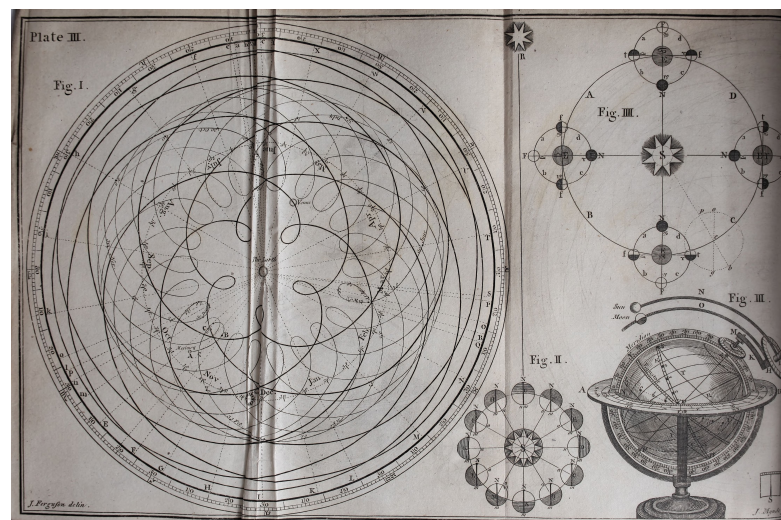


Figure 1.6: Illustration of the movement of planets according to geocentric models of the solar system (in *Astronomy Explained* by James Ferguson, 1794)

traced very complicated paths through the heavens – do we risk the same lack of perspective by continually placing humans at the centre of everything?

While there are healthy debates among educators and communicators about focusing on individual pro-environmental behaviours versus broader systems change (Climate Outreach 2021), the systems-level actions are still often presented from the perspective of individuals participating in larger systems through consumer and civic behaviours. It was Shove's (2010) critique of climate policy that opened up a new way of thinking about these issues that de-centres humans. On the one hand,

this argument felt like a straw man, as the field of environmental education research had long moved past the type of linear ABC model (attitude, behaviour, choice) being critiqued, although practice and policy may have lagged behind. However, this gateway to theories of social practice (Shove et al. 2012) – and eventually the theory of practice architectures (Kemmis 2022) – greatly influenced my thinking and shaped the first paper. Environmental education, from this social practice perspective, would fully recognise the agency of humans in the Anthropocene but view it in social and ecological terms rather than focusing on individual actions and pro-environmental behaviours.

1.5 Hopeful futures

Before turning to the literature review, there is one last reference point for the development of this thesis: the concepts of climate hope and futures literacies, which are woven through the three articles and are central to the work I plan to continue after completing my doctoral studies.

When I began engaging with young people through focus groups and digital storytelling workshops, it became clear that concerns about the future weighed heavily on them, and yet they also resisted simple narratives of green utopia and climate dystopia. I saw parallels with Haraway’s argument of ‘staying with the trouble’ as opposed to ‘a comic faith in technofixes, whether secular or religious’ or, alternately, ‘a position that the game is over, it’s too late, there’s no sense trying to make anything any better, or at least no sense having any active trust in each other in working and playing for a resurgent world’ (2016, 3).

Latour ascribes our negative trajectory to elites giving up on a common future with humanity:

Dramatizing somewhat extravagantly, let us call it a conflict between modern humans who believe they are alone in the Holocene, in flight toward the Global or in exodus toward the Local, and the terrestrials who know they are in the Anthropocene and who seek to cohabit with other terrestrials under the authority of a power that as yet lacks any political institution (2018, 90).

To make sense of Haraway’s ‘making kin’ between human and nonhuman, and Latour’s calls for ‘terrestrial’ politics, I turned to the more accessible writing of Robin Wall Kimmerer and her argument, building on indigenous traditions, for relationships of reciprocity between people and the more-than-human world (2020).

Navigating these visions of a future shaped by climate change and our collective response to the climate crisis, I frequently encountered invocations of hope – in the UK Department for Education’s climate and sustainability strategy, articles on climate anxiety in medical journals, and books by Rebecca Solnit, Katharine Hayhoe, Jane Goodall and Michael Bloomberg (Department for Education 2022, Godlee 2021, Solnit 2016, Hayhoe 2022, Goodall and Abrams 2022, Bloomberg and Pope 2017). Hope in these different contexts can mean different things, from enthusiasm about climate solutions to antidotes to climate despair. In terms of climate education, I have found models of constructive and active hope, which reflect a cognitive and emotional process in which people are invited to positively shape the future, as particularly relevant (Macy and Johnstone 2022, Ojala 2012). I also have grown interested in hope-based pedagogies for climate education, in particular the modes of critical and transformative hope, and plan to further explore the educator practices that support climate hope in learners (Webb 2013).

In 2004, early in his political career, Barack Obama addressed the Democratic National Convention and spoke about the ‘audacity of hope’, a phrase he used as the title of a book published shortly before he began his campaign to become the first African American president of the United States (Obama 2006). Obama was inspired by sermons that referenced the 1886 painting *Hope* by George Frederick Watts, an ambiguous portrayal of a blinded figure of hope sitting on a desolate planet, plucking the single string of a broken lyre (Figure 1.7).

The more I engage with hope, the more challenging and rewarding I find the concept. Introducing a collection of essays and artwork for children compiled during the coronavirus pandemic, children’s author Katherine Rundell offered this reflection:

I think stories of transformation, of wild glories and everyday glories, of magic both real and imaginary, can act like a map. They give us a push towards hope. Real true hope isn’t the promise that everything will be



Figure 1.7: ‘Hope’ by George Frederic Watts and assistants, 1886 (Tate Britain)

all right – but it’s a belief that the world has so many strangenesses and possibilities that giving up would be a mistake; that we live in a universe shot through with the unexpected (2021, xv).

There is a quote attributed to activist Mariame Kaba, which has replaced ‘12 years’ on the t-shirts printed by the Sunrise Movement: ‘hope is a discipline’ (Sunrise Movement n.d.). I like the potential double meaning of this phrase, framing hope as both a practice requiring dedication and work, and as a field of study. In the sense that hope can also be a guide, illuminating a path towards a desired goal, over the past 3.5 years I’ve become a disciple of hope.

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2

Literature Review

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This chapter of the thesis report combines the interdisciplinary academic literature upon which this doctoral research builds. As each of the papers that follows includes a similar section, there is some repetition between this chapter and what follows, but this chapter offers a comprehensive view of the literature drawn upon in order to devise the research questions, carry out the empirical work, analyse the findings and develop conclusions. The final chapter includes a discussion of how this research engages with and reconciles theories and debates across different disciplines.

2.1 Environmental education

The origins of environmental education as an academic discipline can be traced back to the creation of the Journal of Environmental Education in 1969, with the first issue including an attempt by Stapp to define this new field of research and practice: ‘Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution’ (1969, 31). An early milestone in the field was the 1977 Intergovernmental Conference on Environmental Education in Tbilisi, USSR, which resulted in a declaration of the goals of environmental education that still resonate today:

The goals of environmental education are:

- a) to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;
- b) to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;
- c) to create new patterns of behaviour of individuals, groups and society as a whole towards the environment (UNESCO 1978, 26).

The question of how education can support pro-environmental behaviours has long been of interest to environmental education researchers, as noted in the previous chapter. Simplistic models, for example that changes in knowledge will lead to changes in behaviour, have been challenged by researchers and psychologically informed models of pro-environmental behaviour have become increasingly complex (Hungerford and Volk 1990, Kollmuss and Agyeman 2002).

2.1.1 Action competence and education for sustainability

The concept of action competence was developed by Danish environmental and health education researchers in reaction to shortcomings of both knowledge-based approaches that fail to achieve desired changes in behaviour and behaviour modification campaigns that manipulate students into choosing a set of predetermined pro-environmental behaviours (Jensen and Schnack 1997). Action competence is defined

as, ‘a critical, reflective and participatory approach by which the developing adult can cope with future environmental problems’ (Breiting and Mogensen 1999, 350). Olsson et al. (2020) identified three components of action competence: knowledge of action possibilities, confidence in one’s own influence, and willingness to act.

30 years after the Tbilisi Declaration – and two years into the UN Decade of Education for Sustainable Development (Buckler and Creech 2014) – leaders in environmental education gathered in Ahmedabad, India to discuss the connection between education and sustainable development (4th International Environmental Education Conference 2007). With the adoption of United Nations Sustainable Development Goals (SDGs) in 2015, education for sustainable development was formally included as Target 4.7 and the related indicator defined as: ‘Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education and (d) student assessment’ (United Nations n.d.). Education as a tool for accomplishing the SDGs is further described in UNESCO’s ESD for 2030 roadmap and the Berlin Declaration on Education for Sustainable Development (UNESCO 2020, UNESCO 2022).

2.1.2 Climate education

Climate education has more recently emerged from this tradition of environmental and sustainability education. In the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC), Article 12 covers formal and informal climate education, which was operationalised through the Glasgow work programme on Action for Climate Empowerment at the 26th Conference of the Parties (COP26) to the UNFCCC (United Nations 2015, United Nations 2021a). Also at COP26, a summit of Education and Environment Ministers reaffirmed their commitment to climate education in formal education systems, non-formal and informal learning, and training of ‘a workforce attuned to sustainability’ (United Nations 2021b). Education has been discussed as a key theme for COP28 in Dubai in 2023 (Dubai Cares 2023), although this perhaps may reflect the fact that climate

education is perceived as less politically contentious compared to issues such as phasing out fossil fuels and funding loss and damage.

As an emerging field of research and practice, there is still some debate about what constitutes good climate education (Facer et al. 2020). A review of climate education research and evaluation found it was most effective when it focuses on personally relevant and meaningful information, and uses active and engaging teaching methods, with climate education teaching strategies including engaging in deliberative discussions, interacting with scientists, addressing misconceptions, and implementing school or community projects (Monroe et al. 2019). Another review of climate education pedagogies reported that, ‘top-down, science-based approaches in formal educational settings [are] continuing to dominate the field of climate change education’ while calling for an approach that ‘empowers children and young people to meaningfully engage with entanglements of climate fact, value, power, and concern across multiple scales and temporalities’ (Rousell and Cutter-Mackenzie-Knowles 2020, 12–13). A recent study of teachers in England found widespread support for interdisciplinary and action-oriented climate education (Howard-Jones et al. 2021).

Turning to the theoretical underpinnings of climate education, Reid (2019) invoked Biesta’s framework for the purpose of education – with the functions of qualification, socialisation and subjectification (Biesta 2020) – and applied them to climate change education (CCE):

1. The qualification domain concerns ‘the acquisition of knowledge, skills, and dispositions.’

In the context of CCE, qualification might involve providing participants with the knowledge, skills, and dispositions that allow them to ‘do something’—e.g., knowing why climate change is something important to address in their lives, and those of others.

2. The socialization domain is about ‘the ways in which, through education, we become part of existing traditions and ways of doing and being.’

In the context of CCE, socialization, whether explicitly or implicitly, might be concerned with integrating individuals into existing social, cultural and political orders through the transmission of norms and values—e.g., learning to work with others to advance solutions to climate change problems in the local to wider communities they are a member of.

3. The subjectification domain refers to the ‘subjectivity’ or ‘subjectness’ of those we educate.

In the context of CCE, subjectification might focus on positioning students as ‘subjects of initiative and responsibility rather than as objects of the actions of others’—e.g., appreciating how climate change challenges affect the horizons for justice in my/your life, and the choices I/you can make to take action, mindful of the dynamics and context of my and others’ lives too (2019, 777-778).

Busch et al. reflected on epistemologies and methodologies of climate education research, and a current transition in the field: ‘While environmental education has a long and storied history of promoting transgressive and transformative research and pedagogy... such work is just beginning to surface in climate change education as the research begins to shift away from the science of climate change to what do we actually do about climate change’ (2019, 963). In addition, Verlie has argued that climate education must be concerned with emotional responses of young people and adaptation to change that is already unfolding, emphasising ‘affective adaptation’ and the ‘the emotional grit that learning to live-with climate change requires’ (2019, 760).

2.2 Sustainable schools

The design, construction and operation of schools also has implications for environmental sustainability. Guidance on school design and construction emphasises that schools have complex and at times conflicting design requirements in terms of comfort, adaptability and energy performance (Palmer and Mumovic 2015). Through the concept of ‘architecture as pedagogy’, Orr connected the design of schools with the goals of environmental education:

What makes a place a good educational environment? How might the typical classroom be altered to encourage ecological awareness, creativity, responsiveness, and civility? How might materials, light, sounds, water, spatial configuration, openness, scenery, colors, textures, plants, and animals be combined to enhance the range and depth of learning? (2004, 115)

In terms of the environmental footprint of school buildings and operations, the 2010 UK school carbon management strategy reported the school sector was responsible for 7.3 million tonnes of carbon dioxide emissions in 2006, an increase in 12% from 1990, which was broken down into three categories: energy (50%), procurement (29%), and travel (16%) (Department for Children, Schools and Families 2010).

The drivers of energy demand at a typical school have been identified as space heating (60%), hot water (16%), catering (12%), lighting (8%), and office equipment and other uses (4%) (Carbon Trust 2012). The 2016 Building Energy Efficiency Survey, a government review of non-domestic building stock in England and Wales, reported that the education sector was comprised of 47,500 premises with a total floor area of 80 million m² and annual energy consumption of 15,020 GWh (Department for Business, Energy & Industrial Strategy 2016). With 40% of schools constructed between 1940 and 1985, the survey's abatement model found that energy consumption in the education sector could be reduced by 45% with a £2.1 billion capital investment. The UK government's Non-Domestic Smart Energy Management Innovation Competition included a special focus on schools, resulting in a handful of demonstration projects including the successful Energy Sparks initiative (Department for Business, Energy & Industrial Strategy 2019).

In April 2022, the UK Department for Education published a new sustainability and climate change strategy with the vision that the United Kingdom become 'the world-leading education sector in sustainability and climate change by 2030' (Department for Education 2022). This document outlined ambitious plans for climate education, decarbonisation of school buildings and operations, and the restoration of nature on the school estate. As a policy paper – as opposed to legislation – the strategy did not change the national curriculum or school funding in England (education is a devolved issue and controlled separately by the governments of Scotland, Wales and Northern Ireland) (Dunlop and Rushton 2022). However, this potential roadmap raised the profile of school sustainability to the highest level since the 2006 National Framework for Sustainable Schools, which had set a goal

for all schools to become sustainable schools by 2020, and was quietly shelved after the 2010 election (Department for Education and Skills n.d.).

2.2.1 Whole-school approaches to sustainability

Sustainability activities in schools that integrate the environmental performance of facilities, the impact of operations, and learning outcomes for students are often referred to as ‘whole-school’ approaches. An early review of whole-school sustainability programmes provided the following definition of this holistic approach:

Whole-school approaches to sustainability incorporate all elements of school life such as school governance, pedagogical approaches, curriculum, resource management, school operations and grounds. Whole-school approaches can imply links and/or partnerships with the local community (Henderson and Tilbury 2004, 9).

UNESCO has promoted whole-school approaches, with a recent roadmap for achieving the SDGs through education emphasising this holistic perspective: ‘The entire learning institution needs to be aligned with sustainable development principles, so that learning content and its pedagogies are reinforced by the way facilities are managed and how decisions are made within the institution’ (UNESCO 2020, 28). Researchers have proposed a flower model for whole-school approaches to sustainability (Figure 2.1), which captures the interrelated dimensions of school leadership, operations, teaching practices, and the connections with the wider community (Mathie and Wals 2022, Wals and Mathie 2022).

In the UK, two manifestos were recently co-created by educators, learners, and researchers that echo the importance of whole-school approaches: Young People’s Learning and the Environment by the UK National Association for Environmental Education (NAEE) and the Manifesto for Education for Environmental Sustainability by the British Education Research Association (BERA). The BERA document presented solutions at the scales of the classroom, school, and community, while the NAEE publication articulated actions for school leaders, teachers, learners and the school organisation as a whole (British Education Research Association 2021, National Association for Environmental Education 2022).

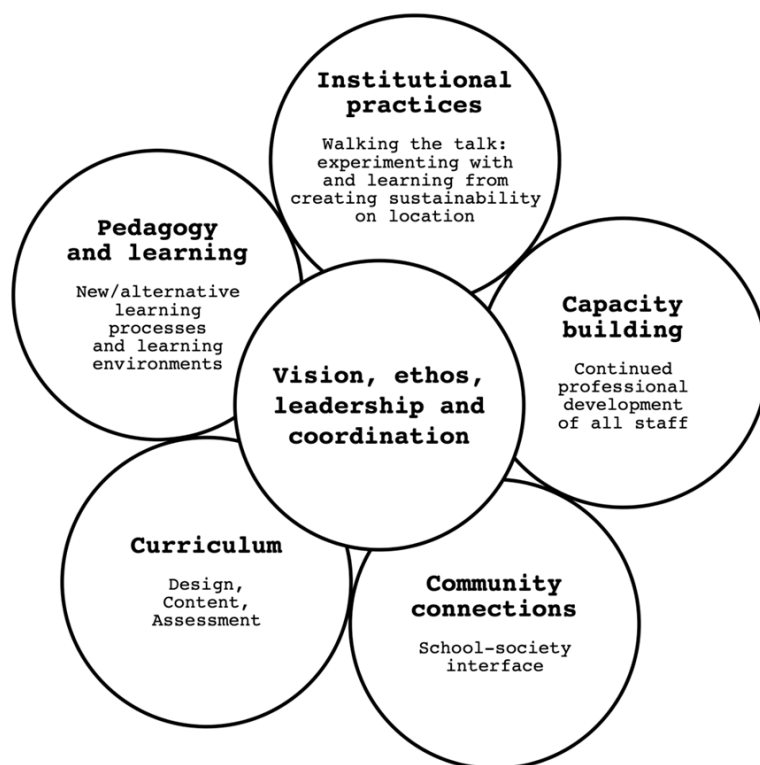


Figure 2.1: Whole-school sustainability flower model (adapted from Wals and Mathie 2022)

2.3 Young people, climate change, and the future

While climate education and sustainable schools are the cornerstones of this research, it also more broadly engages with how young people are responding to climate change. The United Nations defines ‘youth’ as people between the ages of 15 and 24 years old. The 1.2 billion young people born between 1999 and 2008 make up 16% of the global population (United Nations n.d.). They were born after scientific consensus on anthropogenic climate change, and after governments had begun to make commitments to tackle the crisis; the Intergovernmental Panel on Climate Change was created in 1988 and released the first two Assessment Reports in 1990 and 1995, while the UNFCCC was adopted in 1992, followed by the Kyoto Protocol in 1997. Atmospheric carbon dioxide has increased from 368 to 419 parts per million and average global temperatures have risen by 0.5 degrees Celsius from 1999 to 2023 (Scripps 2022, Met Office 2022). For 15–24-year-olds, the threat of climate

change, and the reality of increasing greenhouse gas emissions and rising global temperatures, has been present their entire lives.

2.3.1 Climate anxiety

Previous research has found that young people have similar knowledge and attitudes with respect to climate change when compared to older age groups (Corner et al. 2015). However, more recent studies indicate a sharp rise in a sense of urgency and anxiety among youth, with a large-scale global survey finding that 69% of respondents under 18 years old believe climate change is an emergency, compared to 58% of the respondents over 60 years old, and a large international study of youth reporting that 84% of respondents were worried about climate change, with 59% very or extremely worried (Flynn et al. 2021, Hickman et al. 2021). This generational concern is reflected in the Fridays for Future school strikes, which at their peak in September 2019 attracted over 6 million young people and their supporters worldwide (Taylor et al. 2019). The influence of the latest wave of the youth climate movement is illustrated by recent research on the ‘Greta Thunberg Effect’ in the United States – familiarity with the Swedish teenager and climate activist predicted intention to participate in collective action to mitigate climate change across all ages (Sabherwal et al. 2021).

2.3.2 Climate futures/imaginaries

The second and third papers of this research explore the perspectives of young people with respect to a future shaped by anthropogenic climate change and our collective response in terms of mitigation and adaptation. Futures are of interest across the social sciences. Mische (2009) called for a ‘sociology of the future’, arguing that cultural sociologists should pay as much attention to future projections as they do to collective memories. In science and technology studies, Jasanoff defined sociotechnical imaginaries as: ‘collectively held, institutionally stabilised, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances

in science and technology’ (2015, 4). Levy and Spicer (2013) identified four different climate imaginaries: fossil fuels forever, climate apocalypse, techno-market and sustainable lifestyles. Milkoreit extended this thinking into the concept of socio-climatic imaginaries, which incorporate both social and natural systems, as well as undesirable and mixed possible futures (2017). At the level of individuals and human psychology, Andrews described the combination of imagination and narrative as, ‘a bridge traversing the pathway between what is known, and what can be known, between the present and possible futures’ (2014, 5).

Futures thinking also has practical applications. Anticipating the future can also take different forms: calculating futures using models, imagining futures through visualisation and storytelling, and performing futures with simulations (Anderson 2010). In Japan, a Future Design movement has emerged in which people represent imaginary future generations in planning discussions, with the aim of ‘activating a human trait called futurability, where people experience an increase in happiness because of deciding and acting to forego current benefits in order to enrich future generations’ (Saijo 2020, 2). In Wales, the Well-being of Future Generations Act of 2015 established a Future Generations Commissioner to advise government bodies on sustainable development and the long-term impacts of their decisions (National Assembly for Wales 2015). Reflecting on a collaboration between artists and academics exploring climate futures in Spain and Portugal, Galafassi et al. concluded, ‘visioning then is not something one does once and for all (as in forming an image), but rather it is a continuous process of making the future present in order to discover preferences towards certain futures and taking actions in the present towards an evolving purpose’ (2018, 8). In addition, climate and geography education researchers have long advocated for developing ‘futures literacies’ (Facer and Sriprakash 2021, Hicks and Holden 1995, Morgan 2015).

2.3.3 Climate hope

As mentioned in the introductory chapter, the exploration of young people, climate change and the future in this research has incorporated ideas of climate hope.

The concept of hope has been explored by a number of influential educational theorists. Dewey (2008, 294) distinguished hope from optimism, arguing that optimism ‘encourages a fatalistic contentment with things as they are’ while hope – or what the pragmatists called meliorism – is an active process, in which ‘by thought and earnest effort we may constantly make better things’. Freire (2014, 2–3) also commented on the relationship between hope and action: ‘That is why there is no hope in sheer hopefulness. The hoped-for is not attained by dint of raw hoping. Just to hope is to hope in vain’. Snyder’s hope theory defines three components of hope: goal identification and a combination of pathways thinking and agency thinking – ‘the perceived capacity to use one’s pathways to reach desired goals’ (Snyder 2002, 251).

A number of researchers have applied hope theory to environmental and sustainability education, often in response to concerns about climate anxiety among children (Kelsey and Armstrong 2012, Kerret et al. 2020, Ojala 2017). Ojala (2012) created a survey to capture climate hope through questions exploring three concepts: trust in one’s ability to influence environmental problems in a positive direction, trust in others, and positive reappraisal, which involves thinking differently about environmental problems in a way that activates hope. Building on the measures developed by Ojala, Li and Monroe (2018) developed a scale to measure climate hope among teenagers organised around Snyder’s hope theory, with components covering what they describe as willpower (agency thinking) and waypower (pathways thinking) at both a personal and collective level.

Ojala (2012) also makes a distinction between constructive hope – the ability to identify and pursue alternative pathways to reach desired goals – and climate change hope based on denial, which represents a lack of concern about the future as a result of climate scepticism. In non-academic writing, similar concepts have been explored using the phrase active hope (Macy and Johnstone 2012). In a study of Swedish high school students, Ojala (2015) found constructive hope was higher when teachers accepted their students’ negative emotions about social and environmental problems, while also maintaining a positive and solution-oriented outlook in the

classroom. Kerret et al. (2020) investigated hope-enhancing programmes at schools in Israel, concluding that more research was required in terms of how to best design school activities to enhance environmental hope. Li and Monroe (2018) also called for more research into the link between climate hope and action competence.

2.4 Theories of social practice

As mentioned in the introductory chapter, this research has also been influenced by theories of social practice, with the first of the three papers that follow exploring the patterns of activity that contribute to a school's environmental impact and the factors that hold in place unsustainable practices or are required to enable more sustainable practices. A review of climate and energy education found educators mostly focus on individual energy consumption behaviours, with the researchers calling for environmental and sustainability education that, 'more explicitly addresses the role of collective action, multiactor networks, and sociotechnical innovation in shaping energy transition processes' (Jorgenson et al. 2019, 168). Researchers have also critiqued sustainability and climate change policy as overly focused on individual choice and behaviour change rather than the broader context of social structures and practices (Shove 2010).

Research engaging with social practices takes the practice itself as the unit of study and analysis, rather than the people who enact these practices, thus shifting the focus from individual behaviours to the broader patterns of activity, context, and distributed agency of sociotechnical systems (Trist and Bamforth 1951). Reflecting on the practice turn in philosophy and social theory, including the work of Bourdieu and Giddens, Schatzki defines practices as, 'embodied, materially mediated arrays of human activity centrally organized around shared practical understanding' (2001, 11). Schatzki identifies bundles of practices and the material arrangements that facilitate these practices as central to social analysis (2012). Shove et al. propose that practices are made possible through the interdependent relationships between three elements: material, competence and meaning (2012). This conceptualisation

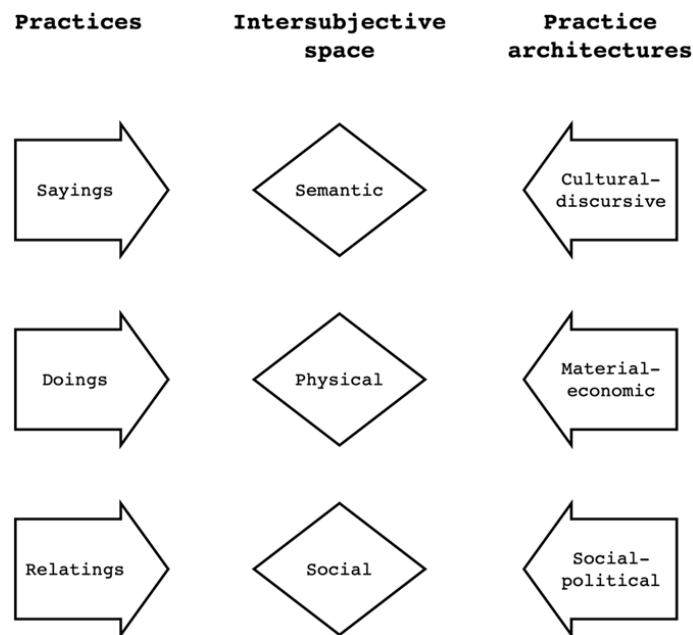


Figure 2.2: The theory of practice architectures (adapted from Kemmis 2022)

was adapted into a more accessible shorthand when discussing the elements of social practices with school stakeholders: stuff, skills and story.

2.4.1 Practice architectures

Building on the theories of social practice above, Kemmis developed the theory of practice architectures to analyse the relationships between practices and arrangements (2022). In this model, practices are interactionally secured in sayings (evident in participants' cognitive understandings), doings (evident in participants' skills and capabilities) and relatings (evident in participants' values, feelings, emotions). Practice architectures are the conditions that make practices possible: cultural-discursive arrangements, material-economic arrangements, and social-political arrangements. Practices unfold in the intersubjective spaces (where people encounter one another) that are semantic (as interlocutors in the medium of language), physical (as embodied persons in the medium of activity and work) and social (as social beings in the medium of solidarity and power). Figure 2.2 is a greatly simplified version of the theory of practice architectures summary diagram.

Kemmis uses the metaphor of a river to describe the relationship between practices and practice architectures:

The relationship between practices and the arrangements that enable and constrain them is like the dialectical relationship between a river and its bed and banks. The bed and banks ordinarily enable and constrain the river's flow. Slowly and gradually, however, the flow of the river causes erosion which slowly alters the river's course... Neither the river, nor its bed and banks, are entirely fixed and final; both are to some extent malleable, dialectically adapting to each other as conditions change (2022, 83).

2.4.2 Social practices and learning

Connecting practices back to education, a number of researchers have explored the relationship between social practices and learning. Lave and Wenger's seminal work on situated learning identified the participation in social practices as a key aspect of learning, for example, how apprentices move from the periphery to full participation in a community of practice (1991). Building on developments in cultural-historical activity theory by Vygotsky and Leont'ev, Engeström highlighted the possibility of learning to transform practices: 'Expansive learning is a type of learning needed and generated in radical transformations of entire activity systems and fields of activity' (2015, xix). Kemmis – debating the relationship between practices and learning with Schatzki – defined learning as 'coming to know how to go on in practices, or coming to be able to go on in practices, or coming to participate differently in practices, or, most simply, coming to practise differently' (2021, 282). Perhaps unique among social practice theorists, Kemmis has directly applied his theory of practice architectures to environmental, sustainability and climate education (Kemmis and Mutton 2012, Kemmis 2022). As a result of this intersection of practice, learning and sustainability, and the possibilities the theory of practice architectures offered as a heuristic model for exploring sustainability in schools, Kemmis was a major figure in the development of my thinking over the course of this research.

Social practices can also be understood in relation to Biesta's three domains of the function and purpose of education in society – qualification, socialisation,

subjectification – which were mentioned earlier in this chapter. While qualification describes the formal curriculum and the transfer of knowledge and skills to learners, socialisation captures the hidden curriculum of ‘cultures, traditions, practices’, and subjectification refers to the development of agency and ‘our freedom to act or refrain from action’ (Biesta 2020, 93). In school, through both qualification and socialisation, young people are recruited as carriers of practices (Shove et al. 2012).

2.5 From theory to methods

As is clear from the above literature, the three papers in this thesis reflect a range of academic disciplines. They also incorporated mixed methods for data collection and analysis that draw on different research traditions, while acknowledging the ‘messiness’ of research that aims to understand complex social phenomena (Law 2004).

The research into social practices of school sustainability was undertaken through semi-structured interviews and focus group conversations with different school stakeholders at a number of secondary schools. Previous research contends that research participants are able to talk about their lives to provide insights into social practices, and that both interviews and focus groups are appropriate methods for practice-based research (Hitchings 2012, Browne 2016). The large number of interviewees and focus group participants was also an effort to overcome the limitations posed by COVID-19 in terms of access to schools to collect observational data. The qualitative data collected through focus groups and interviews was analysed using reflexive thematic analysis (Braun and Clarke 2006)

The second paper used a questionnaire to collect quantitative data from secondary school students and teachers. The questionnaire included recently developed and validated surveys to measure climate hope (Li and Monroe 2018), action competence (Olsson et al. 2020), future scenarios (Grund and Brock 2019), climate emotions (Wahlström et al 2020), and teacher practices (Ojala 2015). The quantitative analysis of questionnaire data, for example of correlations based on demographic subgroups and scores for scales, followed the general guidelines of Campbell and Swinscow in terms of the strength of relationships (2009).

The third paper incorporated a form of creative, participatory research for data collection and visual and narrative methods of analysis. Digital storytelling, as reflected in the International Digital Storytelling Conference, is rooted in the community arts work of the American charity StoryCenter (StoryCenter n.d.). This model of storytelling involves a facilitated workshop in which people without any filmmaking experience produce short, first-person, multimedia narratives. Digital storytelling has been adopted in a variety of educational, organisational, and developmental contexts, including the Patient Voices programme in the UK (Hardy and Sumner 2018). A systematic review of digital storytelling in research confirmed its contribution as a participatory, sensory, visual research method, especially as the visceral nature of multimedia stories ‘capture sensory data not accessible via written word or interview’ (de Jager et al. 2017, 2574). Hogan and Pink argue that visual methodologies involving creative expression are also a means of accessing the interior world of affect, or interiority, through a ‘paradigm that views inner states as being in progress, rather than ever static’ (2012, 233). After leading a digital storytelling project that shared the voices of older people in rural England living more sustainably, Gearty concluded, ‘narrative and storytelling can play an important role in both action research and action learning by helping individuals not only learn through the telling of their own stories but also through their engagement in the stories of others’ (2015, 160).

Turning to the analysis of the data generated through the digital storytelling process, Rose’s criteria for critical visual methodologies are useful reference points: ‘one that thinks about the agency of the image, considers the social practices and effects of its viewing, and reflects on the specificity of that viewing by various audiences, including the academic critic’ (2016, 17). With narrative analysis, Riessman (2008) argues that we are able to better understand the structure of stories and intention of storytellers by treating an entire narrative as an analytical unit, rather than coding small excerpts of text (or transcripts) out of context. Reflecting on the combination of narrative and visual turns in human sciences, Riessman commented, ‘the power of the camera is turned over to research participants to record

images they choose, and to story their meanings collaboratively with investigators' (2008, 143). The power of digital storytelling, both as participatory research method and creative environmental education intervention, is explored in the third paper.

With this background in theory, public policy and research methods, we now turn to the three papers which make up this doctoral research. Each of the following three chapters begins with a brief introduction followed by the full manuscript of the published or submitted (if still under peer review) article.

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3

The social practices and practice architectures of sustainability at secondary schools in England

The manuscript that follows was submitted to the journal *Energy Research & Social Science* on 17 April 2023 (originally submitted 7 February 2023) after a revision based in reviewer feedback, and is currently under peer review. I have decided to present this article first in the thesis, despite it being the last to be completed, as it represents the foundational work of engaging with a range of school stakeholders on questions related to the practices of sustainability inside and outside of the classroom. The main strength of this article is the large amount of qualitative data collected from stakeholders at twelve secondary schools: 61 students participated in focus group conversations, 72 other school stakeholders participated in semi-structured interviews, and an additional nine interviews were conducted with experts in school sustainability. With respect to the literature review of the previous chapter, this article draws on the theory of practice architecture developed by Stephen Kemmis and whole-school approaches to sustainability advocated by environmental education researchers such as Arjen Wals.



Original research article

Beyond whole-school approaches to sustainability: Social practices and practice architectures at secondary schools in England

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ABSTRACT

The education sector is an important component of the UK's net zero strategy, in terms of both the carbon footprint of school buildings and operations, and the opportunities to teach about environmental issues and empower climate action. However, school sustainability is often narrowly defined around individual choices and behaviours by different school stakeholders, rather than the broader patterns of social practices. This qualitative study of secondary schools in England involved stakeholder interviews and student focus groups at twelve schools in Greater London and the Thames Valley Region (Berkshire, Buckinghamshire, Oxfordshire) where 142 people participated in this research, including teachers, students, parents, governors and school staff (leadership, facilities, finance). School sustainability was explored through the lens of social practice theory, and three bundles of practices and arrangements were identified: teaching/learning, catering/eating, movement/travel. Whole-school approaches to sustainability were reframed through the semantic, material and social spaces identified in the theory of practice architectures. School sustainability requires a substantial investment into retrofitting school buildings, but it also needs to be woven in the culture of a school – firmly on the agenda of the governors and leadership team, parallel to an issue like safeguarding – and supported by clearly identified roles and relationships in each institution. This research is aimed at environmental educators and researchers wishing to apply insights from social theory to develop more effective whole-school approaches to sustainability. This research also reveals a potential divide between state and private schools when it comes to environmental education, empowerment and action.

1. Introduction

In April 2022, the UK Department for Education published a new sustainability and climate change strategy with the vision that the United Kingdom become 'the world-leading education sector in sustainability and climate change by 2030' [1]. This document outlined ambitious plans for climate education, decarbonisation of school buildings and operations, and the restoration of nature on the school estate. As a policy paper – as opposed to legislation – the strategy did not change the national curriculum or school funding in England (education is a devolved issue and controlled separately by the governments of Scotland, Wales and Northern Ireland) [2]. However, this potential roadmap raised the profile of school sustainability to the highest level since the 2006 National Framework for Sustainable Schools, which had set a goal for all schools to become sustainable schools by 2020, and was quietly shelved after the 2010 election [3].

School sustainability research emerged from the field of

environmental education, based on the recognition that the physical environment of education and the way in which schools operate can reinforce or contradict messages of sustainability in the classroom [4,5]. School energy consumption has also been explored through energy and emissions modelling and studies of feedback to building users [6–8]. While energy research has engaged with theories of social practice in recent years [9,10], the focus of much environmental education research remains rooted in individual pro-environmental behaviours and behaviour change [11,12].

Bridging the fields of environmental education and energy research, and building on theories of social practice and practice architectures [13,14], this research investigated the following questions at secondary schools in England:

- What are the patterns of activity that contribute to the environmental impacts of schools and the social practices of school sustainability?

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- How can an understanding of practices, and the arrangements that support them, enable more effective and transformative whole-school approaches to sustainability?

In this research, a broad organising concept of sustainability has been adopted, rather than a specific focus on energy or climate change in schools. This is motivated by the holistic or whole-school approaches to school sustainability described in more detail below, as well as the observation that school stakeholders fluidly discussed a wide range of environmental issues during the data collection process, for example, responding to prompts about climate and energy by talking about plastics and oceans. The sustainability issues discussed with school stakeholders have clear energy and climate implications, for example the energy consumption and carbon emissions associated with the manufacture of plastics [15] and food production [16], which were further explored through the bundles of social practices identified below.

The article begins by providing additional background on school sustainability, before turning to the theory and methods of this research. The results section is organised around the two research questions and reports on key practices that take place in secondary schools: practices of teaching and learning, practices of catering and eating, and practices of movement and travel. The results section also presents a connection between social practices and whole-school approaches using the practice architecture concepts of semantic, material, and relational spaces. The discussion section includes a series of recommendations for school stakeholders based on the sayings, doings and relatings of sustainable school practices.

This research aims to support environmental education research and practice through the application of insights from social theory and energy research to holistic approaches to school sustainability. With data collected between the peak of the Fridays for Future school climate strikes and the UK hosting of the international climate meetings in Glasgow, it captures a moment of high interest in climate change among different school stakeholders, and provides guidance for meaningful climate action in schools.

2. Theory and background

Schools have become the frontlines of the latest wave of youth climate activism, after Greta Thunberg's solitary protest inspired millions of young people around the world to join the Fridays for Future school climate strikes [17]. However, the importance of education and learning to support a transition to a more sustainable society has long been recognised internationally, dating back to the 1977 Tbilisi Declaration at the first intergovernmental conference on environmental education, hosted by the United Nations Environment Programme and United Nations Educational, Scientific and Cultural Organisation (UNESCO) [18]. More recently, the 26th Conference of Parties to the United Nations Framework Convention on Climate Change in 2021 (COP26) resulted in a joint statement from education and environment ministers and the Glasgow work programme on Action for Climate Empowerment which outlines the national responsibilities for climate education under the Paris Agreement [19,20].

A review of climate and energy education found educators mostly focus on individual energy consumption behaviours, with the researchers calling for environmental and sustainability education that, 'more explicitly addresses the role of collective action, multiactor networks, and sociotechnical innovation in shaping energy transition processes' [21]. Researchers have also critiqued sustainability and climate change policy as overly focused on individual choice and behaviour change rather than the broader context of social structures and practices [22]. This research project investigates school sustainability through a social practice lens, exploring the patterns of activity that contribute to a school's environmental impact, and the factors that hold in place unsustainable practices or are required to enable more sustainable

practices.

2.1. Theories of social practice

Research engaging with social practices takes the practice itself as the unit of study and analysis, rather than the people who enact these practices, thus shifting the focus from individual behaviours to the broader patterns of activity, context, and distributed agency of socio-technical systems [23]. Reflecting on the practice turn in philosophy and social theory, including the work of Bourdieu and Giddens, Schatzki defines practices as, 'embodied, materially mediated arrays of human activity centrally organized around shared practical understanding' [24]. Schatzki identifies bundles of practices and the material arrangements that facilitate these practices as central to social analysis [25]. Shove et al. propose that practices are made possible through the interdependent relationships between three elements: material, competence and meaning [26].

A number of researchers have explored the relationship between social practices and learning. Lave and Wenger's seminal work on situated learning identified the participation in social practices as a key aspect of learning, for example, how apprentices move from the periphery to full participation in a community of practice [27]. Building on developments in cultural-historical activity theory by Vygotsky and Leont'ev, Engeström highlighted the possibility of learning to transform practices: 'Expansive learning is a type of learning needed and generated in radical transformations of entire activity systems and fields of activity' [28]. Kemmis – debating the relationship between practices and learning with Schatzki – defined learning as, 'coming to know how to go on in practices, or coming to be able to go on in practices, or coming to participate differently in practices, or, most simply, coming to practise differently' [29].

Social practices can also be understood in relation to Biesta's three domains of the function and purpose of education in society: qualification, socialisation and subjectification [30]. While qualification describes the formal curriculum and the transfer of knowledge and skills to learners, socialisation captures the hidden curriculum of 'cultures, traditions, practices', and subjectification refers to the development of agency and 'our freedom to act or refrain from action' [31]. In school, through both qualification and socialisation, young people are recruited as carriers of practices [32].

2.2. Practice architectures

Building on the theories of social practice above, Kemmis developed the theory of practice architectures to analyse the relationships between practices and arrangements [33]. In this model, practices are interactionally secured in sayings (evident in participants' cognitive understandings), doings (evident in participants' skills and capabilities) and relatings (evident in participants' values, feelings, emotions). Practice architectures are the conditions that make practices possible: cultural-discursive arrangements, material-economic arrangements, and social-political arrangements. Practices unfold in the intersubjective spaces (where people encounter one another) that are semantic (as interlocutors in the medium of language), physical (as embodied persons in the medium of activity and work) and social (as social beings in the medium of solidarity and power). Fig. 1 is a greatly simplified version of the theory of practice architectures summary diagram.

Mahon et al. identify a number of features of the theory of practice architectures that distinguish it from other theories of social practice, arguing that it: '(a) politicises practice; (b) humanises practice; (c) theorises relationships between practices; (d) adopts an ontological perspective...; and (e) offers insights pertaining to education' [34]. For example, by extending Schatzki's conception of practices as doings and sayings to a model combining doings, sayings and relatings, practice architectures incorporate notions of relationships and power. In addition, the humanising aspect of practice architectures, especially in terms

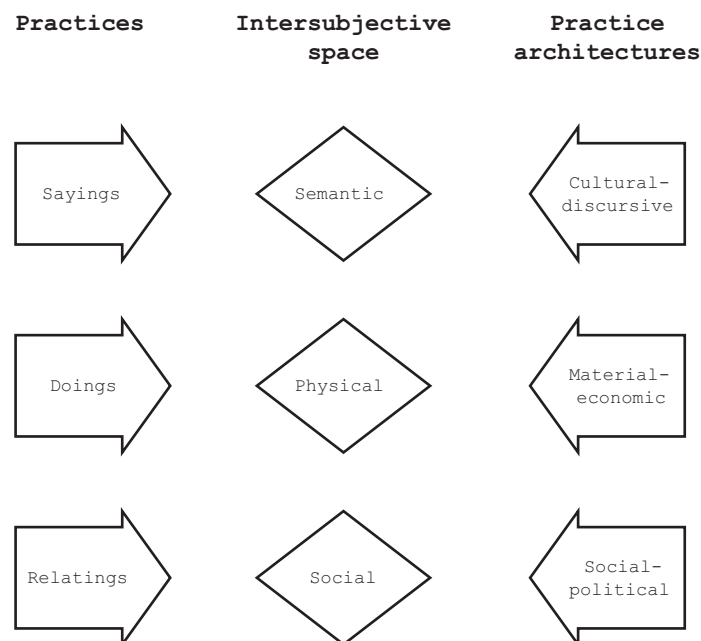


Fig. 1. The theory of practice architectures.
(Adapted from Kemmis [33].)

of the position of human agency and the process of education and learning, was appropriate for this research.

Kemmis uses the metaphor of a river to describe the dialectical relationship between practices and practice architectures: ‘The bed and banks ordinarily enable and constrain the river’s flow. Slowly and gradually, however, the flow of the river causes erosion which slowly alters the river’s course.... Neither the river, nor its bed and banks, are entirely fixed and final; both are to some extent malleable, dialectically adapting to each other as conditions change’ [35]. Kemmis has applied practice architectures to environmental, sustainability and climate education [36–38]. The theory of practice architectures has the potential to offer new insights into the discursive, material and social arrangements that could enable and support more sustainable school practices, complementing existing whole-school approaches. This practice-based research shifts the focus from individual student or staff decisions and behaviours – for example, if a student or teacher composts and recycles waste generated during lunch – to the material infrastructure, situated knowledge, collective meaning, and interpersonal relationships required for a bundle of practices and arrangements to be more sustainable.

2.3. Secondary schools in England

Education is a devolved policy in the United Kingdom, meaning that the governments of Scotland, Wales and Northern Ireland each set their own curricula, funding formulae and systems for assessment and inspection [39]. In England, compulsory education begins at age five, and by the age of 11 pupils start secondary school in what is known as Year 7 or Key Stage 3 [40]. Key Stage 4 begins in Year 10, when students begin to specialise in academic subjects and prepare for their GCSE exams. Key Stage 5 – the final, non-compulsory phase of secondary school, also known as Sixth Form – is when students aged 16 to 18 prepare for A-level examinations (16-year-olds can also pursue apprenticeships, traineeships and other options for further education) [41].

The formal education landscape of England dramatically changed after the Academies Act of 2010 [42]. Academies are schools that receive government funding and are managed by an academy trust (a not-for-profit company), which is a departure from maintained or community schools, which are schools managed by their local authority.

There are currently 3444 state-funded secondary schools in the UK – 2770 (80 %) academies and 674 (20 %) maintained schools [43]. This shift from local authority maintained schools to state-funded but independently managed academies and multi-academy trusts has limited the direct control and support provided by local governments [44].

In England there are 2408 independent schools with a total headcount of 591,954 pupils, or 6.5 % of all primary and secondary school students (many private schools span primary and secondary years, and government statistics don’t provide a more detailed breakdown) [45]. Despite the small percentage of students in privately-funded education in England, the Deaton Review of inequality in Britain found significant disparity between state and independent schools in terms of resources per pupil during schooling, as well as future academic achievement and financial rewards as a result of their education [46]. In this article, the phrases ‘independent school’, ‘private school’, and ‘privately-funded school’ are used synonymously, based on the common usage identified by the Department of Education [47].

2.4. The environmental impact of schools

School sustainability can be understood in terms of the environmental footprint of school buildings and operations. The 2010 UK school carbon management strategy reported the school sector was responsible for 7.3 million tonnes of carbon dioxide emissions in 2006, an increase in 12 % from 1990 [48]. The 2006 schools carbon footprint was broken down into three categories: energy (50 %), procurement (29 %), and travel (16 %). A 2012 report by the Carbon Trust looked specifically at school energy consumption, with the energy demand at a typical school comprised of space heating (60 %), hot water (16 %), catering (12 %), lighting (8 %), and office equipment and other uses (4 %).

The 2016 Building Energy Efficiency Survey, a government review of non-domestic building stock in England and Wales, reported that the education sector is comprised of 47,500 premises with a total floor area of 80 million m² and annual energy consumption of 15,020 GWh [49]. With 40 % of schools constructed between 1940 and 1985, the survey’s abatement model found that energy consumption in the education sector could be reduced by 45 % with a £2.1 billion capital investment. With dramatic increases in the cost of energy in 2022, the Department for

Education surveyed schools about energy suppliers, developed guidance for energy efficiency practices, and provided £500 million for energy efficiency retrofits [50–52].

Guidance on school design and construction emphasises that schools have complex and at times conflicting design requirements in terms of comfort, adaptability and energy performance [53]. The design of schools has an impact on educational outcomes [54,55], and this extends to what is formally and informally taught about sustainability, or what Orr refers to as ‘design as pedagogy’ [56].

2.5. Whole-school approaches to sustainability

Sustainability activities in schools that integrate the environmental performance of facilities, the impact of operations, and learning outcomes for students are often referred to as ‘whole-school’ approaches. An early review of whole-school sustainability programmes provided the following definition of this holistic approach: ‘Whole-school approaches to sustainability incorporate all elements of school life such as school governance, pedagogical approaches, curriculum, resource management, school operations and grounds. Whole-school approaches can imply links and/or partnerships with the local community’ [57].

UNESCO has promoted whole-school approaches, with a recent roadmap for achieving the Sustainable Development Goals through education emphasising this holistic perspective: ‘The entire learning

institution needs to be aligned with sustainable development principles, so that learning content and its pedagogies are reinforced by the way facilities are managed and how decisions are made within the institution’ [58]. The flower model (Fig. 2) captures the various dimensions of whole-school sustainability [59,60].

The collection of exemplary practice in whole-school approaches to sustainability by Mathie and Wals included case studies from sixteen countries across Africa, the Americas, Asia and Europe [61]. Researchers such as Lotz-Sisitka have investigated school sustainability in the Global South, from the formal curriculum and teacher practices to the integration of sustainability into the operations of higher education institutions such as Rhodes University in South Africa [62,63].

2.6. School sustainability frameworks

In the UK, a number of frameworks for sustainable schools have been proposed to operationalise whole-school approaches, including:

- National Framework for Sustainable Schools (2006): this policy – introduced by a Labour government but discontinued by the coalition government of the Conservatives and Liberal Democrats – outlined eight ‘doorways’ to sustainable schools and influenced the Building Schools for the Future investment in new educational facilities [64,65].



Fig. 2. Whole-school sustainability flower model. (Adapted from Wals and Mathie [59].)

- Eco-Schools: the charity Keep Britain Tidy manages the Eco-Schools programme in England (the international network of Eco-Schools is overseen by the Foundation of Environmental Education in Denmark). Eco-Schools offers a structured seven-step process for schools to earn the Green Flag award, which includes developing an action plan based on three of ten potential thematic topics [66].
- WWF-UK COP26: the charity WWF-UK was the educational partner with the UK government when it hosted COP26. In addition to a large presence at the event, WWF-UK worked with a number of partners to develop and disseminate a series of resources, including materials for a climate action workshop in which schools make a ‘promise to the planet’ [67].
- Let’s Go Zero: an initiative of the charities Ashden and Global Action Plan, through Let’s Go Zero schools can sign on to the aspiration of becoming zero carbon by 2030 – as of April 2023 over 2000 schools in the UK had signed up [68]. The campaign includes support in eight thematic areas.

Table 1 outlines the key themes in these four initiatives and the flower model of whole-school sustainability. This thematic comparison illustrates the similarities and differences between these different frameworks, although there is additional potential overlap in the implementation of these programmes. For example, the seven-step process of Eco-Schools includes a step for connecting the chosen themes to the curriculum, and the Let’s Go Zero campaign has developed an online action planner that includes pathways for community, culture, curriculum and campus.

While these existing sustainability initiatives cover many of the dimensions of the whole-school approach, there are notable exceptions. For example, while sustainability content in the curriculum is noted in multiple programmes, they don’t explicitly address how this content is taught and learned – the pedagogy petal of the whole-school flower. In addition, while other initiatives might imply the need for staff training and professional development to accomplish goals related to

sustainability, the whole-school approach highlights this need for capacity building. These initiatives also include aspects not covered by the whole-school model, especially in terms of global connections and future careers.

Of these frameworks, the Eco-Schools programme is the most widely adopted, with the Foundation for Environmental Education reporting that over 59,000 schools in 68 countries participated in Eco-Schools between 1994 and 2019 [69]. In England, 1,478,364 young people attended schools that participate in Eco-Schools in the 2021–2022 school year, with outcomes reported such as 96,580 pupils participating in a litter-pick and 37,865 trees planted on school grounds [70]. Research has found that Eco-Schools initiatives have mixed impacts in terms of learning outcomes and behaviour change, and that the transformative change promised by whole-school approaches remains elusive [71,72].

The sustainable school frameworks above provided an entry point into the conversations with school stakeholders and initial reference point for the reflexive thematic coding of the interview and focus group data. A number of the schools that participated in this study were involved in both the Eco-Schools and Let’s Go Zero programmes, and both initiatives were discussed in interviews.

3. Methods

This study focuses on secondary schools in England. Secondary schools were chosen, rather than primary schools, as they are complex institutions with specialised staff. In addition, students in sixth form could reflect on their school experience and future plans, and were at an age where they might have participated in the Fridays for Future school climate strikes. The twelve schools that participated in this study (see Table 2) were initially recruited through the UK Schools Sustainability Network, which emerged after the climate strikes to connect young people and the teachers that supported their climate action in regional and national networks. This network was used to identify a school staff member (either teaching or non-teaching) with a role connected to sustainability (either formally or informally) that could serve as a gateway to other stakeholders. As the first round of schools to join this research project were predominantly independent schools, additional state schools were recruited through referrals from other schools and personal relationships. All of the state schools participating in this study were academies.

In each school, semi-structured interviews were conducted with different school stakeholders, which may have included one or more representatives from the leadership, finance, and facilities teams, teachers, governors, and parents, adding up to 67 interviews (with 72 interview subjects, as a small number of interviews included multiple

Table 1
Thematic comparison of sustainable school frameworks.

Whole-school approaches to sustainability ('flower' model)	Sustainable schools framework ('doorways')	Eco-schools England topics	WWF-UK school promises to the planet	Ashden Let's Go Zero campaign
Vision, ethos, leadership and coordination	Inclusion and participation		Culture	
Curriculum			Curriculum	Curriculum
Pedagogy and learning				
Institutional practices	Food and drink Energy and water Purchasing and waste Buildings and grounds Travel and traffic	Healthy living Energy Water Waste Litter School grounds Biodiversity Transport	Campus	Food Energy Water Procurement Waste Nature Transport
Capacity building				
Community connections	Local well-being		Community	
Not explicitly covered by the whole-school flower model	Global dimension	Global citizenship Marine	Careers	

Table 2
Participating schools by type/category.

	State	Independent	Total
Number of schools	6	6	12
Average pupil population [73]	1516	808	1162
Proportion of pupils in this study	65 %	35 %	100 %
Location: Greater London	0	4	4
Location: Berkshire	1	2	3
Location: Buckinghamshire	2	0	2
Location: Oxfordshire	3	0	3
Single-sex schools	1 (girls' school)	2 (girls' schools)	3 (girls' schools)
Religious schools	0	1 (Quaker)	1
International Baccalaureate schools	0	1	1
State academies	6	N/A	6
State maintained schools	0	N/A	0
Academically selective state schools	2 (grammars)	N/A	2

stakeholders with the same role or related roles) across the twelve schools. An additional nine interviews were conducted with school sustainability experts with experience working in multiple schools, including two staff members at local authorities that provided support for school sustainability. Interviews lasted between 20 and 60 min. School interviews began in January 2021 and continued during the spring and summer school terms in the 2020–2021 academic year. As this research took place during the COVID-19 pandemic, during which school policies restricted visitors, most of the interviews were conducted using video conferencing software.

Focus groups were conducted with students at ten of the schools, with 61 sixth form students participating. The focus group format, using the same questions as the interviews, was chosen to maximise the potential student voice while also responding to the safeguarding requirements of the participating schools. Table 3 shows the number of interviewees and focus group participants by stakeholder group and school type, and in the results section these are referred to using a code combining the school type and stakeholder group (for example, S1-L would be a member of the senior leadership at a state school, and I2-G would be a governor at an independent school).

Transcripts of the interview and focus group recordings were coded using reflexive thematic analysis to iteratively develop and refine the themes shared in the results section [74]. This analysis was also informed by critical discourse analysis, especially in terms of the relationship between language and social practice [75].

The primary limitation of this research is related to it being conducted while schools were responding to the coronavirus pandemic, which greatly disrupted school operations. While COVID-19 also limited access to the participating schools, it was possible to visit ten of the participating schools, and observations and notes from these relatively brief visits – and any additional materials shared by interview subjects about school sustainability activities – informed the interpretation of qualitative data described above. Previous research contends that research participants are able to talk about social practices, and that both interviews and focus groups are appropriate methods for practice-based research [76,77]. The large number of interviewees and focus group participants was also an effort to overcome the limitations posed by COVID-19. The decision to set the boundaries of the research at individual schools, in terms of the participating stakeholders, is also a potential limitation of this research given the growing importance of centralised teams for multi-academy trusts and affiliated independent schools. The discussion below includes recommendations for future research based on the limitations of this study.

4. Results

This section begins with general observations about school sustainability before turning to aspects of the two research questions identified in the introduction. Three bundles of social practices in secondary schools have been identified related to sustainability: teaching/learning, catering/eating and movement/travel. Whole-school approaches to

Table 3
Research participants by stakeholder group and school type.

	State (S)	Independent (I)	Other	Total
Facilities (Fa)	3	6		9
Finance (Fi)	3	5		8
Governor (G)	5	5		10
Leadership (L)	7	5		12
Parent (P)	5	11		16
Teacher (T)	9	8		17
Student (S) ^a	29	32		61
Expert (E)			9	9
Total	61	72	9	142

^a Students participated in focus group conversations rather than individual interviews.

sustainability were also integrated with the theory of practice architectures, which are represented below through diagrams of the semantic, material and social dimensions of school sustainability practices. The tables in this section include representative quotations from the stakeholder interviews and student focus group discussions.

The interviews and focus group conversations revealed the importance at each school of the eco-leads, the person at each school acting as a formal or informal champion for sustainability, often a young teacher or staff member. These eco-leads were working with small groups of students to raise the profile of sustainability in their schools – in the classroom, in the canteen, and in the culture of the school – in response to growing concerns about climate change. A variety of stakeholders recognised the importance of sustainability, especially reducing the use of energy consumed and waste generated through school practices. However, transformative, school-wide responses were very limited, and most of the schools in this study were early in their journeys to becoming more sustainable.

The response of schools to climate and sustainability was markedly different between state and independent schools. The discourses around sustainability at private schools appeared responsive to the interests of students and parents as customers in a competitive marketplace. At the state schools in this study, sustainability efforts were often led by staff and teachers that expressed concern about limited involvement from students, while initiatives at independent schools had more student involvement and leadership, and these schools in general appeared more supportive of student voice and empowerment. As better resourced institutions, the independent schools in this study were also more likely to have formally supported a staff member as an eco-lead through dedicated time and funding. This marks a potential state versus independent divide in education for environmental sustainability.

Staff from the leadership and finance teams at both state and independent schools identified the lack of financial resources as hampering their responses to climate change. As a state school bursar commented:

If someone came along and said, ‘Right, here’s a million pounds, make the school as energy efficient as you can,’ and gave me two years to plan it and do it properly – rather than try and spend it in six months, which is the usual thing with government funding – then we would be able to do all those sorts of things.

(S1-Fi)

The headteacher at an independent school reflected that for her school to fully integrate sustainability it would take, ‘some kind of radical rethinking, a bit of bravery, and quite a lot of money’ (I6-L).

4.1. Whole-school approaches to sustainability

The whole-school approach to sustainability introduced above was represented as a flower, with petals for the various dimensions of sustainability across the sociotechnical system of a school and vision at the centre. Table 4 connects these components to the conversations with school stakeholders.

The whole-school model illustrates how sustainability cuts across various activities and roles at a school. For example, the community energy project mentioned above touches on the technical infrastructure related to electricity on the school site, the opportunity to study real-world climate and energy solutions in the classroom, and relationships between the school and the wider community. The whole-school model also hints at the combinations of sayings, doings and relating reflected in practices, and the parallel practice architectures that maintain them. However, at the schools in this study, the implementation of sustainability campaigns often boiled down to individual choices of different actors in a school, for example student behaviour in the canteen, or the bursar’s assessment of capital projects.

At all of the schools included in this study, the senior leadership team – especially the head teacher – and the school governors controlled key decisions with respect to whole-school sustainability. At the same time,

Table 4

Summary of findings and sample quotations related to whole-school approaches to sustainability.

	Summary of findings	Quotations
Vision, ethos, leadership and coordination	The culture of a school – codified into values, transmitted by the leadership – can be an obstacle or an enabler to school sustainability. For example, the school in this study with the highest level of engagement from the governors was a Quaker school with sustainability as one of the seven school values.	‘And an important part of being a Quaker is you should be judged by what you do, and how you behave, perhaps more even than what you say and what you think. So a lot of it is about delivering sustainability in action and in practice. And I think that’s been really important for us’ (I2-Fi).
Curriculum	The content of teaching and learning connects sustainability with the educational purpose of school and the national curriculum of England. Stakeholders talked about the limited inclusion of sustainability in subjects as they are currently taught, with the exception of geography and the International Baccalaureate course on environmental systems and societies.	‘[School should] promote understanding how much of an impact [students] have on the environment. And that kind of comes down to lessons and being taught about it... but it’s not like it’s not part of the curriculum for all of us’ (S3-S).
Pedagogy and learning	The methods of teaching sustainability may differ from conventional teaching practices, for example, teachers mentioned attempts to coordinate within and across subjects and consider the learning journeys/pathways of students over the course of secondary school. Stakeholders also referred to integrating contact with nature, local problem solving, system thinking, and global issues into learning.	‘The way that we live, you use a toilet and you flush it and you don’t know understand how sewage works, or you turn on the tap, you don’t understand how the water arrived or you throw something in the recycling bin and you don’t really know where it goes. And [we need] much more understanding of how you fit in the wider system’ (S2-T2).
Institutional practices	The operation of a school combines the social and technical aspects of the institution, for example the consumption of energy to heat and light school buildings. Most of the schools in this study have older buildings that would be costly to renovate to modern sustainability standards. Procurement was disconnected from the daily life of schools, with significant decisions taking place on multi-year cycles, for example, choosing the energy supplier, caterer, waste collector, etc.	‘[Sustainability] needs to be on the agenda. It needs to be one of those regular [questions], ‘where are we at with our environmental policy?’ It needs to be another safeguarding question, where every meeting, it’s there. You know, ‘What’s going on? What’s the progress?’” (S2-G).
Capacity building	The training and ongoing professional development of teaching and non-teaching staff is essential to the long-term impact of sustainability campaigns. Citing resistance to changes in school practices to be more sustainable, stakeholders	‘And I think the frustration for me is you’ve got people putting so much effort into trying to do the right thing for climate change, and you’ve got others who just can’t be bothered’ (I3-Fa3).

Table 4 (continued)

	Summary of findings	Quotations
	emphasised the importance of addressing both the skills and the story of practices, empowering the school community with action competence, and breaking through the mindset of ‘can’t be bothered’.	
Community connections	Sustainability activities can extend beyond the school estate into surrounding communities. Parents spoke of how their children brought concepts and practices into their homes, as well how environmental awareness can flow from the home back to school. Stakeholders also spoke of support provided by local authorities, partnerships with community energy projects, and the possibility of schools serving as hubs for sustainability.	‘We joined a [community energy] scheme where it’s a community run organization. They sell shares to raise the capital for solar projects and they have, free of charge to the school, covered [a school building] with solar panels’ (S3-Fi).

responsibility for different aspects of managing the school was delegated to specialised roles related to finance, procurement, building and energy management, and teaching different subjects. While private schools control the fees charged to pupils, state-funded schools have no control over the per pupil funding provided through the National Funding Formula, and must bid in a competitive process for limited capital funding, limiting how proactive they can be in implementing whole-school approaches. In terms of the regulation and reputation of schools, Ofsted inspections of state-funded schools do not consider school sustainability, and school performance is primarily assessed through student exams, especially the subject-specific GCSE and A-Level qualifications.

4.2. The social practices of school sustainability

This research engaged a wide range of secondary school stakeholders in conversations about the social practices of sustainability. Interviews and focus groups covered the priorities of that stakeholder and the accomplishments they have observed in terms of how their school was responding to the climate crisis, as well as school activities, desired changes that were beyond the control of that stakeholder, and the sayings, doings and relatings required to support more sustainable practices. Schools were represented as unique institutions, in terms of both the built environment of the facilities and grounds, and the human dimension of how they are used and managed. In terms of energy use profiles, the expert interviewees noted that schools are similar to offices but have different daily and annual patterns, with shorter days and longer holidays. One example of how broader social patterns might conflict with more sustainable practices is the installation of onsite renewable energy, specifically the current business model for installing arrays of solar panels on school buildings, as the peak annual production takes place during the summer holidays when schools are largely empty.

The interview subjects were able to provide examples of practices, as well as the arrangements that are required to support the transformation to more sustainable practices. For example, with respect to waste management (recycling, composting), schools often identified and provided the material (bins for different types of waste) and supported the development of skills and capabilities (signage and assemblies to train people to put waste in the correct bin) but lacked the story and relationships (the motivation and sense of collective ownership to actually put waste in the correct bin). A number of themes were identified in the

reflective thematic analysis of the interview and focus group transcripts which have been organised into three bundles of practices and arrangements that capture the main patterns of activities that take place over the course of a school day (Fig. 3). The first bundle relates to practices of teaching and learning, which reflect the core purpose of schools, something that interview subjects across all stakeholder groups emphasised. The bundle of practices for catering and eating is based on many comments about dining options, especially meat alternatives, food waste and packaging, as a tangible part of the school experience for most stakeholders was participating in a midday meal at school. Another bundle of practices represents movement within a school building over the course of the day (another unique feature of school versus office activity), travel between home and school, and school trips.

It is worth noting that these three bundles are not comprehensive in terms of the full environmental impact and carbon footprint of schools, omitting certain types of resource consumption and technical infrastructure. Rather, the bundles were chosen as they represent key aspects of daily school experiences for the majority of the school community. In each section below, a table is presented with the most commonly identified themes related to the bundle of practices and arrangements for each stakeholder group, with a representative quotation included for reference.

4.2.1. Practices of teaching/learning

Teacher practices involve a wide range of pedagogical approaches and activities related to the qualification, socialisation and subjectification of learners. Teaching as a practice is very much connected to the sayings and thinking in Kemmis' model, with respect to the use of language and development of cognitive understanding. This is also related to how lessons align with the ideas in the national curricula and the assessment of qualifications, and how educators might link a variety of subjects to relevant issues outside of the formal curriculum. In terms of the material element of practices, teaching and learning in schools generally takes place in classrooms which have been purpose-built and furnished to support this fundamental purpose of schools, with additional facilities to support more specialised learning, for example sport, music, drama, design and technology, etc. The relational component of practices for teaching connects with teacher relationships to other school stakeholders and to the culture of their school, as well as their emotional connection to teaching, especially considering the demands and pressures on teachers.

In terms of sustainability, many teachers mentioned the use of paper and printing as a tangible form of waste resulting from teaching activity, especially when coupled with a lack of recycling practices in their school. The use of technology in teaching practices had changed over the

careers of the teachers interviewed, with a recent shift to digital learning materials hastened by how schools responded to the coronavirus pandemic. While this may have decreased the impact of paper and printing, the energy use of information technology in the classroom and home, as well as cloud services for data storage, and the sourcing and disposal of devices like student Chromebooks, raised questions of additional environmental impacts. The energy performance of the classroom also intersected with teacher practices and the use of technology, for example the interaction between content delivered by a teacher using a projector and the use of daylighting and zoned lighting control. To limit the spread of COVID-19, air circulation was increased in schools through natural ventilation, which often meant heating classrooms while the windows were left open. When discussing the missing sayings and relatings that could support more sustainable teacher practices, stakeholders referenced a lack of climate literacy, habits of older teachers, and resistance to change, especially given time pressures and demanding nature of teaching. Reflections by stakeholder on practices of teaching and learning are presented in Table 5.

The energy implications of practices of teaching and learning were primarily related to the consumption of electricity in the classroom for lighting and a range of instructional technologies. The increasing use of computers in the classroom and dissemination of content digitally can be seen in the context of a growing body of research on digital innovations and climate change [78,79].

As the quotations above illustrate, a wide range of perspectives were presented on the use of technology in the classroom, the way sustainability is (or is not) included in the curriculum, and the relationship between teaching/learning and future careers and decisions. While teachers recognised that the practices of teaching can have a positive and negative environmental impact, they emphasised that the education of young people – and the preparation of young people for future careers and as members of society – is the biggest environmental impact of schooling.

4.2.2. Practices of catering/eating

By providing lunch for hundreds of pupils and staff, schools participate in practices of catering and eating. This service tends to be contracted to a catering company that sources, prepares and serves the food. The discourses around food in schools often focused on cost-effective preparation of healthy meals. Food also evokes stories about identity and culture. The material arrangements related to food includes the kitchen equipment used for cooking and refrigeration and objects used for packaging, serving and eating the food, which may be washable and reusable, or disposable. In terms of relationships, dining is a shared experience for the school community.

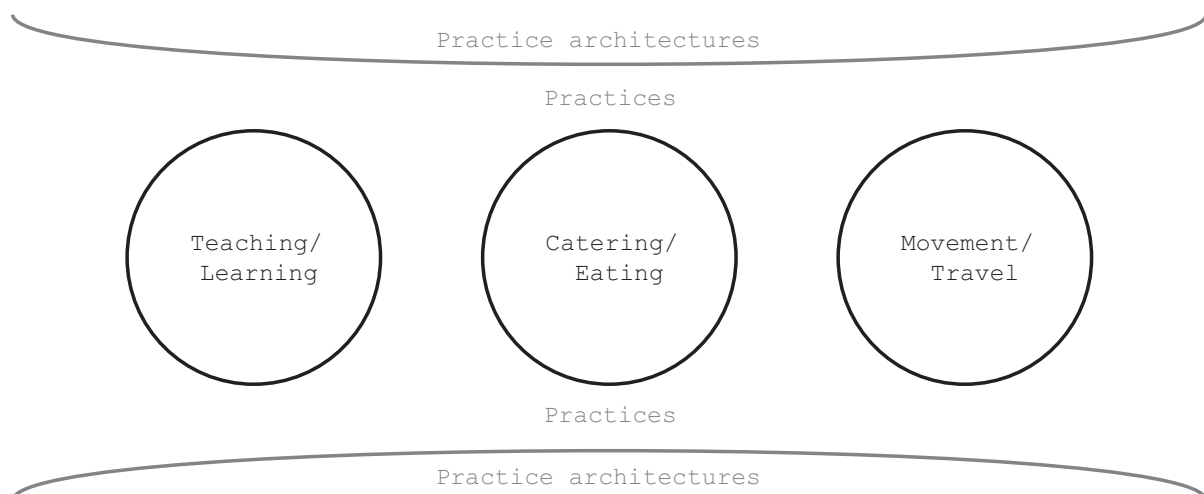


Fig. 3. Bundles of practices and arrangements at schools.

Table 5
Stakeholder themes and sample quotations related to practices of teaching/learning.

	Themes	Quotations
Facilities	Technology in classroom, Heating/lighting control	'Every classroom has got a projector. Majority of the projectors are fairly modern... I'm sure they're a lot more energy efficient than the ones that were out four or five years ago.' (S3-Fa).
Finance	Technology in the classroom, Green design	'There's an important educational aspect to this [green building programme]. I don't think we've got this quite right yet, if I'm honest, but you know, showing students: this is what we've done, this is the investment, this is the actual financial benefit and the environmental benefit of what we've done' (I2-Fi).
Governor	Carbon literacy and footprint, Green careers	'Schools are just not getting how much employment the green economy is going to provide, and how many courses and further education there is out there, and grants and support and capacity for all the people that are going through the school at the moment, they're going to need to know this stuff' (S6-G).
Leadership	Curriculum and cross-curricular	'We're going to talk about where environmental messages fit into the existing curriculum. So, we're not rewriting stuff or creating a massive policy of a document which boringly sits on a shelf and annoys people from time to time. We're just talking about it, and, by talking about it, it'll happen. And that's because it's now being framed as part of actual, real world action' (S2-L).
Parent	Curriculum and cross-curricular, Environmental awareness, Project-based learning	'It needs to be a central core part of the curriculum because this is just as important as history, maths, English, science. And, in fact, it could be taught in all of those different strands... the whole way through school' (I4-P3).
Teacher	Action competence, Critical awareness, Systems thinking	'I think that success is something that I'm not going to see. You know, the successes are a child who makes a decision because that decision has an ecological consequence' (I1-T2).
Student	Curriculum and cross-curricular, Environmental awareness	'I'd like to see the school just kind of promote more kind of eco consciousness within the student body, I'd like to see the school kind of actively push that a bit more.' (S4-S).
Expert	Carbon literacy and footprint, Heating/lighting control	'This is where the <i>smart</i> needs to come in – enabling the user, helping them to do the right thing, but not usurping their authority. So don't turn the lights on for them, but turn them off when they're not there. And allow them to turn them off when they are there. There's quite a lot of the smart lighting systems are not smart at all. We got all the lights on in the classroom, but actually want them off by the whiteboard.' (E2).

When reflecting on the environmental impact of schools, the canteen loomed large, especially for students. There were frequent references to wasted food and the rubbish and litter related to food packaging. Staff commented on the food wasted by students; students criticised the options, portions and quality provided in the canteen. School staff referred to initiatives to phase out single-use plastic, for example plastic water bottles, and install reusable water bottle refill stations. Students and parents also spoke about the availability (or lack of availability) of vegetarian and vegan options. While one school was completely vegetarian (as required by their landlord) stakeholders at other schools reflected on attempts to institute meat-free Mondays, with varying levels of success. Schools were forced to change lunch practices in response to COVID-19 policies that limited dining in lunchrooms and required takeaway options, which had implications for food-related waste, although some schools implemented compostable food packaging. Some school staff were particularly sensitive to potential eating disorders of pupils, and worried about the language of strict, rule-based diets. A summary of themes and example quotations by stakeholder on the practices of catering and eating are presented in Table 6.

While the practices of catering and eating included the use of electricity and gas in kitchens and canteens, and the lifecycle impacts of materials and waste, the primary energy and climate implications are related to the carbon footprint of food choices, especially of meat versus plant-based diets [80].

The quotations above show how the material nature of the procurement, preparation and distribution of food is enmeshed in the culture of the institution, for example the (un)acceptability of removing meat from the menu. The practices of catering and eating also reflect a difference in state versus independent schools, especially boarding schools that provide three meals a day. A member of the leadership team at a state school mentioned the financial implications of more sustainable food practices:

I would love to be more considerate in our cafe, for example, in terms of things we're selling, and what they're made of, and the packaging and whatnot. Then again, there can be a knock-on cost to doing that, which, if you're a 'Free School Meals' child, puts certain items on the menu out of the market for you.... Cost for the family rather than for the school is something that's always at the forefront of my mind and can be a barrier to perhaps having some of the projects and things that we would rather do.

(S3-L1)

4.2.3. Practices of movement/travel

Eleven of the twelve secondary schools included in this study were on campuses with multiple buildings, and over the course of the school day students and staff walk through these spaces – between classrooms, between buildings, and across the school grounds. Students and staff also must travel from home to school, journeys taken through active travel (walking, cycling), public transportation (buses, trains), and by car. Four of the state schools in this study were local schools with a small catchment, meaning that students lived close enough to school to walk or cycle. The other eight schools (two grammar schools and six independent schools) drew from a wider catchment, and included both urban schools with strong public transport links and boarding schools with much less daily travel (although they also had a number of international students that travel by plane multiple times a year). Teaching and non-teaching staff frequently drove to school, and mentioned the lack of affordable housing close to their schools. Another travel practice related to education is school trips, with some schools (especially independent schools) offering multiple international trips a year related to sports and subjects. With international travel put on hold due to COVID-19, some schools found suitable domestic alternatives that could be reached by coach.

The practice of movement through a school on a timetable of short periods has implications for school sustainability. The opening of doors –

Table 6
Stakeholder themes and sample quotations related to practices of catering/eating.

	Themes	Quotations
Facilities	Catering, vegetarian and vegan	'We use an external caterer... and I think as part of the new contracts, we may need to look at the carbon usage of the companies that we're looking at, and maybe that needs to be part of the contract' (S1-Fa).
Finance	Food waste, water bottles and fountains	'That's a classic example of where COVID has accelerated change. You know, we were saying to students, 'bring your own bottle', so we've put these little [water bottle refill] stations in around the place. That's gonna make a big difference for us right now.' (I2-Fi).
Governor	Vegetarian and vegan	'On the food side, possibly the biggest, single, easy win would be to take beef completely off the menu. We can't influence that. What we can do is measure its consumption' (I2-G1). 'I disagree with that. I think we can' (I2-G2). 'Okay, maybe we can. Whether we can influence it sufficiently, I don't know' (I2-G1).
Leadership	Food waste, packaging	'So small things that I think can make a big difference: less packaging, less waste through packaging. Actually because of COVID we've gone back to everything being wrapped up, and I really don't like that' (S6-L).
Parent	Composting, food waste, vegetarian and vegan	'I'm vegan... my girls are vegan, and it's been quite hard to get the school to cater for them properly. My daughters are often given food they shouldn't be given because the staff aren't aware of what vegan means. I've been asking for better labelling, better provision, you know, building more vegan choice or plant-based choice into the actual offering for everyone' (I6-P1).
Teacher	Catering, food waste, packaging, vegetarian and vegan	'Building up that kind of broader systems thinking in the students, you know, when they take a banana, and then they don't eat it. Where has that banana actually come from? How's it got here to our school? And, you know, just throwing it in the bin, what's the impact of that? And I would apply this to the teachers as well' (I5-T).
Student	Choices and portions, food waste, vegetarian and vegan	'I think the main thing that you can do is be vegetarian. If there was more of an education into like your diet and how much impact [eating] meat has on the environment. We don't really know where the meat in the cafeteria actually comes from.' (S3-S).
Expert	Not discussed	

from the classroom to a corridor and from a building to outside – circulates the air and impacts heating requirements. When students and staff leave a classroom, they may leave the lights and other equipment on, unsure of when the room will be used next and whose responsibility it is to switch things off. While motion sensors for lighting and the standby mode for devices can improve energy efficiency in the context of the use and circulation patterns of a school, many school staff reported empty classrooms with the lights on after hours. In terms of promoting more sustainable travel such as cycling to school, stakeholders discussed the materials (cycle paths, racks, sheds, showers), sayings (bike-ability training), and relatings (events like bike to school days to increase motivation and sociability) of the practice of cycling. Parents also revealed concerns about the safety of children cycling to school, which

ties into ideas of protection from harm, and led to parents driving their children to school. Students, teachers, governors, parents and members of the leadership team reflected on the high carbon footprint of international trips, which were part of the privileged culture of some schools. Themes and example quotations by stakeholder on the practices of movement and travel are included in Table 7.

The practices of movement and travel are related to the Scope 1 greenhouse gas emissions of school vehicles and the Scope 3 emissions from student and teacher commuting and school trips and other 'business travel' [81]. Practices related to school travel extend beyond the school gates, and must be understood within the broader context of public policy and technical innovation, for example initiatives to decrease air pollution from transport in London [82].

The excerpts from the interviews and focus group conversations illustrate the frequent mentions of advances in and barriers to more active travel to school. Through these three bundles of practices and arrangements, we can understand the school experience for young people and other school stakeholders – their movement to and from and through the school, their time in lessons which accounts for the majority of the school day, and the daily shared experience of meals. The lens of practice architectures highlights the layered sayings, doings and relatings that comprise practices that are environmentally sustainable and unsustainable. We now turn to how the three layers of practice architectures – cultural-discursive, material-economic and social-political arrangements – can help school stakeholders better understand and support whole-school approaches to sustainability.

4.3. Practice architectures and whole-school approaches

In the previous section, life in a school was understood through a series of specific bundles of practices. At this point we attempt to look holistically at how schools work as semantic, physical and social institutions. In the sections that follow, each dimension of the theory of practice architectures is explored separately. The figures below reflect an effort to systematically map the key elements of each dimension based on the stakeholder interviews. The boxes on the left represent semantic, material and social components of school life, and the ovals connected on the right represent how sustainability could be incorporated into each component.

4.3.1. Practice architectures: semantic dimension

Fig. 4 was developed based on the stakeholder interviews to map the semantic dimension of school practice architectures – where the 'sayings' of practices are shaped by the language and ideas of practice arrangements – including sections for the language of governance/leadership, teaching, and student voice. This illustrates the influence of both the culture of a single school, as well as the broader culture of education and assessment set by national, local and institutional policies, on the understandings of sustainability in a school reflected in the sayings and thinking of school stakeholders. Student voice also emerged as a theme in the interviews, as some schools have more formal mechanisms for students to share opinions and a culture of student empowerment. Students were also very interested in strategies to communicate about environmental issues, and engage both students and staff that didn't currently prioritise sustainability.

4.3.2. Practice architectures: material dimension

Fig. 5 represents the material dimension of school practice architectures – where the material-economic arrangements enable the 'doings' of practices – based on the stakeholder reflections on the school buildings and grounds and the material flows through them. This material dimension also encompasses the technology used to operate the building (heating, lighting) as well as support the practices identified above (classroom teaching, food preparation). The opportunities for sustainability in this space depend on the material arrangements, such as the design of school buildings, as well as economic arrangements, such

Table 7
Stakeholder themes and sample quotations related to practices of movement/travel.

	Themes	Quotations
Facilities	Active travel, cars	'Yet another big [impact] is transport: people driving to school and children being dropped off by car. There'll be someone that lives probably no more than five or ten minutes walking distance but mum or dad is dropping them off. And staff driving to school as well – there's a member of staff that literally is about a three-minute walk but drives every day' (S3-Fa).
Finance	Active travel, infrastructure, public transport	'So, in the last two or three years, we've really encouraged girls to cycle to school, you know, we offer cycle training and storage for their bikes and all of those sort of things. But we still have got to get over a mindset... and I think that there's a gap still between the theory and the practice.' (I6-Fi).
Governor	Infrastructure, school trips	'I think to be totally honest, the one area that stands out for me at the school is the international travel. One of the great things about the school is it offers lots of opportunity – for people to play sports abroad, for people to go on various different trips abroad, experience different cultures, and all of that. Absolutely, it all has a really strong educational meaning and worth. However, it still has a detrimental effect on the environment, and, how we reconcile that and how we have a real debate about that, I think is very difficult' (I3-G).
Leadership	Active travel, cars	'Because of the demographic of a lot of our parents who are quite wealthy... they all have big, you know, SUVs, and they like to drop their children off at school in those cars. And the pandemic has impacted on that – they don't want to be them traveling on trains, and buses, because they're worried, so they dropped them off [by car]' (I6-L).
Parent	Active travel, carbon offsetting, cars, school trips	'My son walks back from school, or we'll go on to an after-school activity or something where either he tries to walk or take a bicycle or something like that' (S4-P1).
Teacher	Active travel, cars, infrastructure, public transport, school trips	'Obviously, getting the teachers at the school every day is probably the important thing. But another thing to think about is what is your school trip? And do you want to try and get by train even though that's really difficult, to go to Paris or somewhere, if it's easier to go by coach or probably a flight?' (S2-T1)
Student	Cars, infrastructure, public transport, school trips	'I think the school does quite well in terms of the journey to school. The vast majority of people living outside walking distance would be using school buses, and cars and car-share if there's no bus available. Although it has to be said that the age of our school transport is so old that the kind of fumes that those things pump out – I don't even stand behind that sort of thing' (S4-S).

Table 7 (continued)

	Themes	Quotations
Expert	Data and analytics	'So we're building at the moment an app to essentially act as a bit of a survey tool. So they would fill it out in terms of tracking how people travelled to school, and then it will give them feedback on the carbon footprint and what happens if they change' (E9).

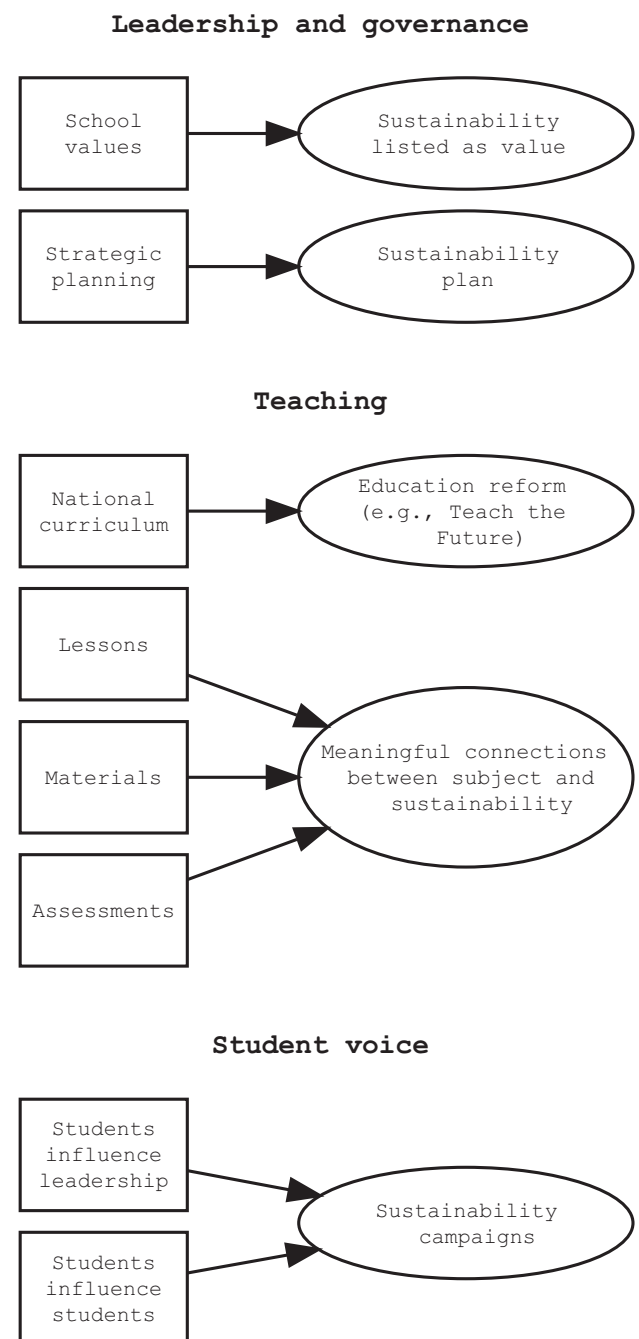


Fig. 4. Semantic dimension of school sustainability practices.

as procurement decisions and suppliers. Schools can also participate in a changing energy system, in which institutions not only consume energy but are also producers through the installation of onsite renewables,

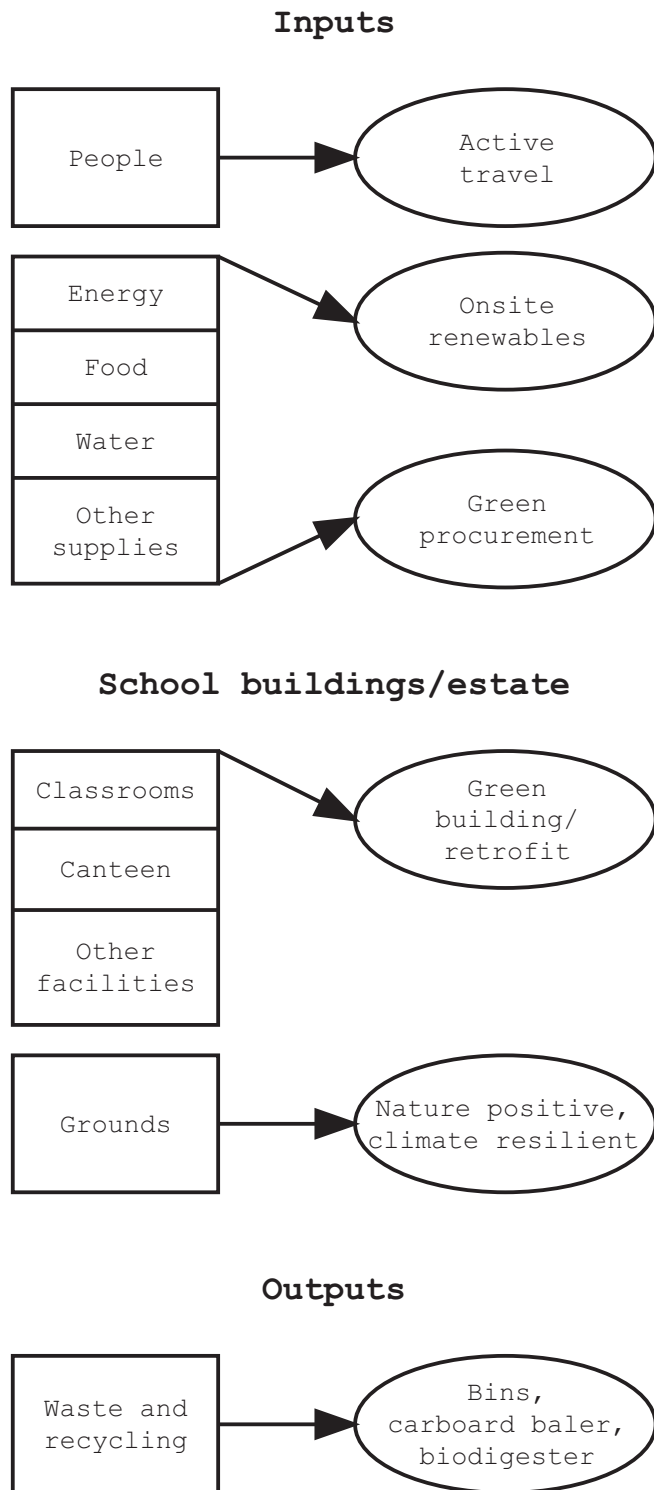


Fig. 5. Material dimension of school sustainability practices.

which can be supported by local financing and produce local benefits through community energy initiatives. While not explored in this diagram, in Kemmis's model this dimension is where skills and capabilities are evident through participants' doings, 'as embodied persons in physical space-time, in the medium of activity and work' [83].

4.3.3. Practice architectures: social dimension

Fig. 6 presents the social space of school practice architectures – where the 'relatings' of practices are made possible by the relationships

and power dynamics of people – based on reflections on the different stakeholders inside and outside a school with a variety of potential roles and relationships that support sustainability. These roles could include (using 'eco' for brevity): eco lead at the local authority or multi-academy trust, eco society for representatives from multiple schools in a local authority or multi-academy trust, eco governor, eco lead on school staff, eco club open to all students, eco council with elected representatives from each year group, eco prefects/ambassadors in sixth form that lead the eco council and represent the school in the eco society and other networks, and an eco committee with representatives from all stakeholders that works through thematic task forces.

These diagrams are an attempt to map the complex social, material and semantic systems that are secondary schools, while also illustrating the cross-cutting nature of sustainability in educational institutions. One goal of this analysis is to reveal key intervention points that would enable and sustain more sustainable schools, which are discussed in the recommendations below.

5. Discussion

In this research project, a wide range of stakeholders at a dozen secondary schools in England shared their experiences of sustainability, discussing challenges, opportunities and successes. The inclusion of both models of whole-school sustainability and theories of social practice shifted the focus from the choices and behaviours of individuals, as characterises much environmental and sustainability education research and practice, to a more holistic perspective on the transformation of the sociotechnical system of a school to respond to the climate and nature crises. In particular, the inclusion of practice architectures as a theoretical framework was novel and fruitful, and illustrates the potential of bridging the disciplines of environmental education and energy research.

This research captured a range of perspectives from school stakeholders, illustrating different understandings of bundles of practices in schools that are related to sustainability. The number of participants involved in semi-structured interviews and focus group conversations, and their diverse roles and expertise, is a strength of this research. Whole-school approaches to sustainability have been proposed as supporting systems thinking and change, incorporating all school activities and stakeholders. Initiatives, such as the Green Flag certification scheme of Eco-Schools, provide a process and thematic framework for schools to systematically engage with environmental issues. However, programmes like this often engage a small percentage of the school community, are seen as a time-bound activity rather than a long-term process, and can be limited to a 'box-ticking exercise' rather than lead to school-wide transformation. The combination of whole-school approaches with a practice-informed understanding of the sayings, doings and relatings of school life could allow schools to more holistically – semantically, materially and socially – engage with sustainability.

The findings above also reflect differences in how state versus independent schools are engaging with sustainability, echoing the Deaton Review of inequality in Britain [84]. This research indicates that disparities in terms of funding and academic performance also translate into how schools are responding to environmental issues such as climate change and biodiversity loss. This potential disparity in school sustainability could have far reaching consequences in terms of personal and collective climate resilience, at a time when educationalists are calling for the state or public education system to be reimagined to support climate mitigation and adaptation [85].

The business model of privately-funded independent schools allows them to invest in material infrastructure to improve the sustainability of operations, from building programmes to equipment upgrades. The independent schools involved in this research were more likely to have teachers or other staff with a formal sustainability role and resources to achieve goals related to sustainability. These private schools were also more likely to encourage student empowerment and voice, and were

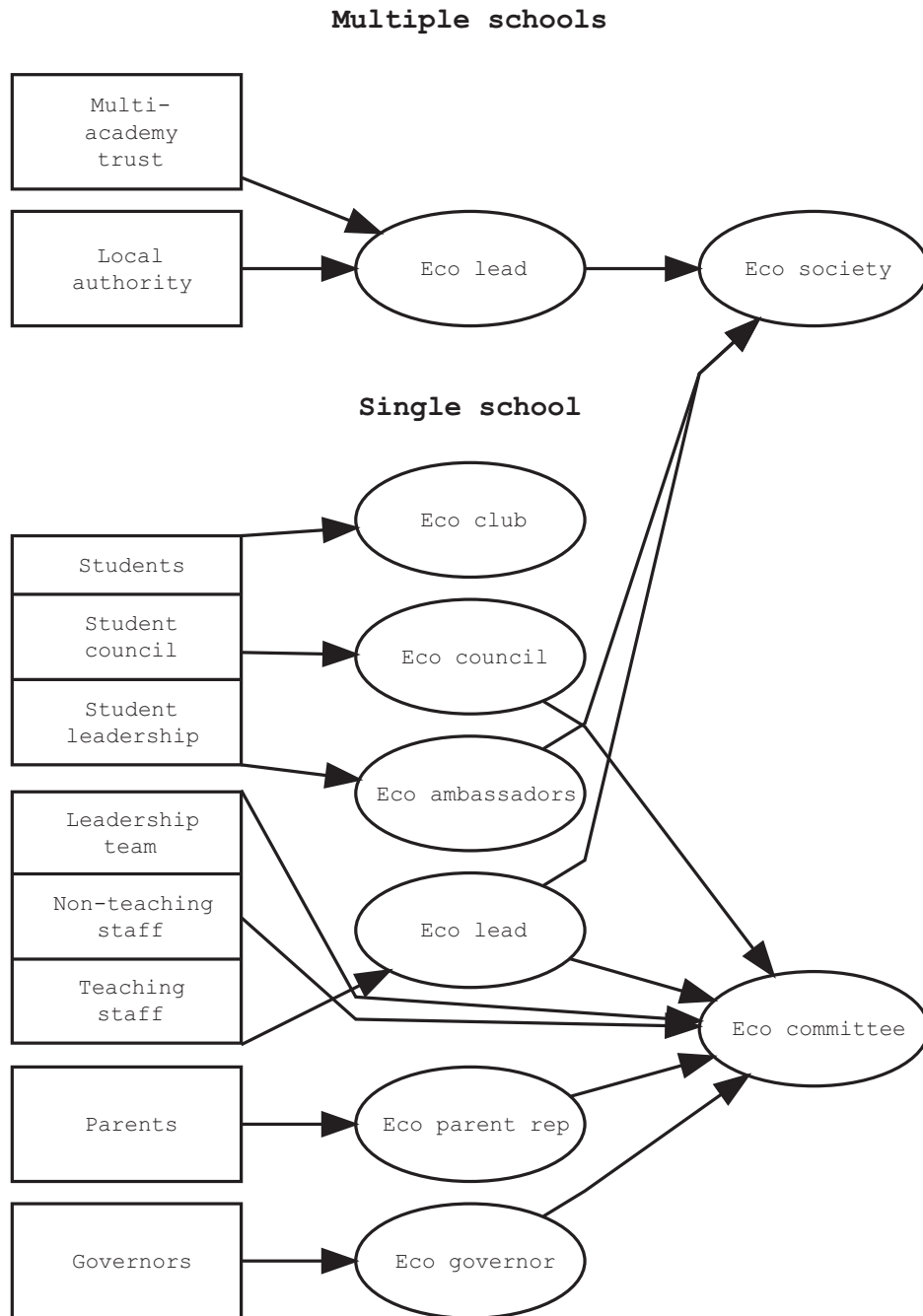


Fig. 6. Social dimension of school sustainability practices.

responsive to the concerns of students and parents, actively marketing their sustainability activities in the competitively marketplace of private education. At the same time, there are certain contradictions inherent in independent schools talking about sustainability while continuing activities, such as international trips, that have very large carbon footprints, as well as questions of equity and justice raised by the relative carbon footprint between independent versus state school pupils (and their families).

5.1. Recommendations

The findings above have been synthesised into a series of recommendations for policy makers and educational institutions, building on the different dimensions of the theory of practice architectures.

5.1.1. Whole-school & practice-informed

Schools that aspire to be more sustainable must take a whole-school approach to sustainability. The guidance and support offered by Eco-Schools, WWF, Let's Go Zero, BERA, NAEE and UNESCO (among others) can help institutions engage with sustainability holistically in terms of buildings, operations and teaching across a range of subjects and thematic areas. However, the lens of social practices and practice architectures reveals that whole-school approaches must also respond to the broader context of both the patterns of activity of school life and the discursive, material and social arrangements required to enable more sustainable activities. The findings of this research indicate that sustainability begins with a commitment by the school leadership team and governors to address sustainability holistically, recognising that it is connected to the social practices of school life and the arrangements that enable or constrain patterns of activity. Whole-school approaches will

often need to extend beyond a single school, especially given the shift towards multi-academy trusts and both the centralised decision-making and economies of scale provided by these trusts.

5.1.2. Sayings

The semantic dimension of practice architectures, as explored in the analysis above, reflects how sustainability is talked about in a school. For the school stakeholders involved in this study, especially teachers, there was recognition that the language of sustainability needs to permeate the school system, from the national curriculum to the school values and strategic planning. This goes beyond holding a school assembly or other one-off event, and requires that the story of sustainability be fully integrated into the culture of a school. While curriculum reform is a slow process, the recent Tracked Changes Review of the national curriculum of England commissioned by the student-led campaign Teach the Future illustrates opportunities for sustainability education across multiple subjects, which can inform teacher practices [86].

5.1.3. Doings

The stakeholders involved in this study – bursars, maintenance teams, governors overseeing capital projects – often wanted to do more when it came to sustainability, but were constrained by lack of funding and the continuous process of accessing competing priorities for limited resources. For schools to walk the talk of sustainability, there is a clear and pressing need for a major school renovation, energy efficiency, and decarbonisation (including onsite renewables) programme funded by the government. This is a long-term investment, reducing operating costs and improving comfort, which also will positively impact learning outcomes. Additional funding would also make it possible for schools to prioritise sustainability in procurement decisions, such as their energy supplier. Support should also be provided for schools in the areas of food and transport, for example the provision of healthy, environmentally-sustainable dining options for all students, and additional infrastructure and incentives for active travel.

5.1.4. Relatings

The eco-leads at different schools were important participants in this research, serving as gateways to other stakeholders and shouldering much of the work of sustainability, often informally and on top of other responsibilities. Creating and supporting clear roles for sustainability at all levels – governors, staff, students – of educational institutions will result in clearer ownership and accountability, as well as improved relationships between different stakeholders. This involves firmly placing sustainability on the agenda of governors and staff, in a similar fashion to an issue like safeguarding, and providing time, resources and support to stakeholders with formal roles related to sustainability. Sustainability also provides opportunities to cultivate relationships beyond a single school – across a multi-academy trust, between nearby state and independent schools, linking the school with the surrounding community, and through emerging networks supporting educators and learners interested in climate action.

5.1.5. Adaptation and resilience

Returning to Kemmis's metaphor of the river of practices, the relationship between a practice (river) and the arrangements that enable it (riverbanks) depends on a healthy ecosystem, in which the river can find its meandering course through a floodplain. In this research, a number of factors were identified that have fortified the riverbank of school practice architectures – old building stock, school cultures and the habits and mindsets of stakeholders, and policies that underfund schools and focus on the siloed assessment of qualifications. For schools to meaningfully respond to the climate crisis, system-wide reforms are required to reshape the river of practices and support adaptation and resilience in a time of change and uncertainty.

5.1.6. Future research

The COVID-19 pandemic limited the ability to directly observe and document practices in this research, with reliance instead on remotely conducted semi-structured interviews and focus group conversations. Future research could further explore environmentally-related practices and practice architectures in schools using a variety of methods. For example, researchers could work in a more embedded way at a single school using observational and ethnographic methods to identify bundles of practices and arrangements, and the dynamics of social practices in response to changes in school policies or other interventions. Researchers could also investigate additional layers of regulatory and financial oversight through interviews with other actors, for example at local authorities, government agencies and multi-academy trusts.

Kemmis described learning as 'coming to practice differently'. In the dynamic relationship between practice, practitioner and practice architectures, the river of educational practices is resisting changes that would enable more sustainable school activity, despite the interest of many school stakeholders and the aspirations of the DfE climate and sustainability strategy. For schools to transform into more climate resilient institutions that prepare young people for a future shaped by climate change, we must quickly and collectively learn and change.

6. Conclusions

This research builds on traditions in environmental and sustainability education, incorporates social theory often absent from this field, and responds to urgent calls for the education sector to respond to the climate and nature crises. Schools are an important component of the UK net-zero strategy, and over 2000 schools have joined a campaign declaring their ambition to be zero carbon by 2030. However, the schools in this study illustrate that educational institutions have a long way to go in their sustainability journey, and are in need of support from the government, especially when it comes to the capital investment required to improve the energy performance of schools.

Guided by the research questions mentioned above, this article set out to explore the social practices of secondary schools, and how these relate to whole-school approaches to sustainability. School stakeholders identified social practices related to teaching/learning, catering/eating, and movement/travel as patterns of activity contributing to their schools' environmental footprints. The methods of interviews and focus groups proved successful in terms of gathering perspectives on practices from a wide range of stakeholders. The theory of practice architectures was utilised to analyse practices as sayings, doings and relatings, leading to recommendations for policy makers and school leadership to overcome the challenges of whole-school approaches and enable more sustainable schools.

This research contributes to whole-school approaches to sustainability, using theories of social practice and practice architectures to provide an ever broader, more holistic foundation for schools to respond to the climate crisis. There are real obstacles to schools decreasing their environmental impact in a way that increases the climate resilience of local communities and learners. This research has clear policy implications, both in terms of aligning national education policy – funding, curriculum, inspections – with the government's net-zero goals, and in terms of the freedom of academies, multi-academy trusts, and independent schools to make the case – both a business case, and one related to their educational mission – for bold climate action.

Schools aspire to prepare young people for the future. As the ability to participate in practices that are more environmental sustainability is increasingly seen as an essential component of life, work and study, educational institutions have an important role to play in both teaching about and modelling the practices of sustainability. This practice-informed, whole-school approach to sustainability transcends a single academic subject or a particular student interest. Sustainability in schools, to put it simply, is about what we do, what we talk about, and how we relate to one another. For schools to play a transformative role

in averting environmental crises, environmental sustainability must be fully integrated across the sayings, doings and relatings both inside and outside of classrooms.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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4

Educating for hope and action competence: a study of secondary school students and teachers in England

The article that follows was submitted to the journal *Environmental Education Research* on 5 April 2022, accepted for publication on 26 August 2022, and published online as an open access article on 11 September 2022. During the peer review process, extensive comments were addressed from four reviewers. As discussed in the introductory chapter, this piece of my doctoral research evolved in response to the Covid-19 pandemic, and offered an opportunity to develop research skills related to survey design and quantitative analysis. This article also engaged with current interest in the field of environmental education in the themes of climate anxiety and hope, replicated the findings of Maria Ojala in Sweden, and developed a new conceptual model for emotionally-mediated education for climate action. In the spirit of open research, the questionnaire, anonymous questionnaire data, and Jupyter Notebook of analysis are available on Oxford University Research Archive (<https://ora.ox.ac.uk/objects/uuid:9b371808-a0f4-4b37-b253-7d524e7ec85e>).

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Educating for hope and action competence: a study of secondary school students and teachers in England

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ABSTRACT

Young people and educators in the UK have called for changes in the education system to better prepare learners for a future shaped by climate change and our collective response to the climate crisis. This research explored both reported climate education practices and future outlooks through a questionnaire completed by 16–18-year-old secondary school students ($n=512$) and teachers ($n=69$) in England. The research participants had mixed emotions about the future, and rated negative future scenarios as more likely than positive scenarios. This is the first study in the UK to directly measure climate hope and action competence using recently developed and validated questionnaires, finding a strong positive correlation between hope and action competence. Replicating previous research, the reported teacher practices that best predicted student-reported hope were 1) accepting negative emotions and 2) maintaining a positive outlook, which was further explored through the model of emotionally-mediated education for climate action. In this study, a complicated picture emerges in which hope and anxiety coexist, and both have a relationship with students' reported environmental action.

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We can no longer let the people in power decide what hope is. Hope is not passive. Hope is not 'bla, bla, bla'. Hope is telling the truth. Hope is taking action (Thunberg 2021).

The latest Intergovernmental Panel on Climate Change (IPCC) report on the physical science of climate change combines the state of our knowledge of the Earth's climate system and human-induced climate change with a series of future scenarios, emphasising that climate change is shaping the future (Masson-Delmotte et al. 2021). Education is concerned with preparing students for the future, with Biesta (2020) arguing that the function of education can be understood as a combination of qualification, socialisation, and subjectification. This raises a question: how can our educational systems effectively prepare young people for a future shaped by climate change and our collective response to the climate crisis?

For educators, effective climate education involves more than expertise in a specific subject; it requires new pedagogical approaches (Monroe et al. 2019; Rousell and Cutter-Mackenzie-Knowles 2020). Educators also need to be aware of the emotional landscape of climate change – a number of recent commentaries in medical journals highlight concerns about high levels of climate anxiety among young people (Godlee 2021; Rao and Powell 2021; Wu, Snell, and

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Samji 2020). This study of 16–18-year-olds in England and their teachers seeks to better understand:

- the future outlook of students, as reflected in their ratings of future scenarios, hope, distress, and action competence,
- the relationship between teacher practices, the future outlook of students, and student participation in school sustainability activities and environmental protest.

Climate education is an emerging field of education research and practice with origins in environmental and sustainability education and strong links to the United Nations Framework Convention on Climate Change (UNFCCC) and United Nations Sustainable Development Goals (Facer et al. 2020; Reid 2019). This research explores emerging themes in climate education that are of interest both to governments responding to calls for education reform and to educators experimenting with new pedagogical approaches. It is the first study of UK youth to directly measure climate hope and action competence using recently developed and validated scales.

The paper begins with a background section reviewing relevant literature in climate education, hope and action competence. A methodology section follows with the research questions, more details about the students and teachers in England that participated in the research, and the elements of the questionnaire used to collect the data. The results section describes the findings with respect to the research questions, and the paper concludes with a discussion of key themes, noting the study limitations and potential directions for future research.

Background

Young people and climate change

The United Nations defines ‘youth’ as people between the ages of 15 and 24 years old. The 1.2 billion young people born between 1997 and 2006 make up 16% of the global population in 2022 (United Nations n.d.). They were born after scientific consensus on anthropogenic climate change, and after governments had begun to make commitments to tackle the crisis; the IPCC was created in 1988 and released the first two Assessment Reports in 1990 and 1995, while the UNFCCC was adopted in 1992, followed by the Kyoto Protocol in 1997. Atmospheric carbon dioxide has increased from 367 to 420 parts per million and average global temperatures have risen by 0.5 degrees Celsius from 1997 to 2022 (Scripps 2022; Met Office 2022). For 15–24-year-olds, the threat of climate change, and the reality of increasing greenhouse gas emissions and rising global temperatures, has been present their entire lives.

Previous research has found that young people have similar knowledge and attitudes with respect to climate change when compared to older age groups (Corner et al. 2015). However, more recent studies indicate a sharp rise in a sense of urgency and anxiety among youth, with a large-scale global survey finding that 69% of respondents under 18 years old believe climate change is an emergency, compared to 58% of the respondents over 60 years old, and a large international study of youth reporting that 84% of respondents were worried about climate change, with 59% very or extremely worried (Flynn et al. 2021; Hickman et al. 2021).

This generational concern is reflected in the Fridays for Future school strikes, which at their peak in September 2019 attracted over 6 million young people and their supporters worldwide (Taylor, Watts, and Bartlett 2019). The influence of the latest wave of the youth climate movement is illustrated by recent research on the ‘Greta Thunberg Effect’ in the United States – familiarity with the Swedish teenager and climate activist predicted intention to participate in collective action to mitigate climate change across all ages (Sabherwal et al. 2021).

Future scenarios

Future scenarios have played a critical role in climate science and policy, describing different potential socioeconomic pathways and their associated greenhouse gas emissions (O'Neill et al. 2020). Scenarios describing pathways that limit climate change are related to sociotechnical imaginaries, a concept in science and technology studies (STS). 'Imaginaries, in this sense, at once describe attainable futures and prescribe futures that states believe ought to be attained' (Jasanoff and Kim 2009, 120). Anticipating the future can also take different forms: calculating futures using models, imagining futures through visualisation and storytelling, and performing futures with simulations (Anderson 2010).

Climate and geography education researchers have long advocated for developing 'futures literacies' (Facer and Sriprakash 2021; Hicks and Holden 1995; Morgan 2015). In a study of Swedish students, researchers argued for education for sustainable development involving 'future teaching based on possible, probable and preferable futures' (Torbjörnsson and Molin 2014, 273). In a recent study of environmental and sustainability education in Germany, students and teachers rated a series of scenarios in terms of desirability and likelihood, with both groups pessimistic about futures shaped by climate change, social inequality and digitisation (Grund and Brock 2019).

Climate hope

The concept of hope has been explored by a number of influential educational theorists. Dewey (2008, 294) distinguished hope from optimism, arguing that optimism 'encourages a fatalistic contentment with things as they are' while hope – or what the pragmatists called *meliorism* – is an active process, in which 'by thought and earnest effort we may constantly make better things'. Freire (2014, 2–3) also commented on the relationship between hope and action: 'That is why there is no hope in sheer hopefulness. The hoped-for is not attained by dint of raw hoping. Just to hope is to hope in vain'.

Snyder's hope theory defines three components of hope: goal identification and a combination of pathways thinking and agency thinking – 'the perceived capacity to use one's pathways to reach desired goals' (Snyder 2002, 251). A number of researchers have applied hope theory to environmental and sustainability education, often in response to concerns about climate anxiety among children (Kelsey and Armstrong 2012; Kerret et al. 2020; Ojala 2017). Ojala (2012) created a survey to capture climate hope through questions exploring three concepts: trust in one's ability to influence environmental problems in a positive direction, trust in others, and positive reappraisal, which involves thinking differently about environmental problems in a way that activates hope. Building on the measures developed by Ojala, Li and Monroe (2018) developed a scale to measure climate hope among teenagers organised around Snyder's hope theory, with components covering what they describe as willpower (agency thinking) and waypower (pathways thinking) at both a personal and collective level.

Ojala (2012) also makes a distinction between *constructive hope* – the ability to identify and pursue alternative pathways to reach desired goals – and climate change hope based on denial, which represents a lack of concern about the future as a result of climate scepticism. In non-academic writing, similar concepts have been explored using the phrase *active hope* (Macy and Johnstone 2012). In a study of Swedish high school students, Ojala (2015) found constructive hope was higher when teachers accepted their students' negative emotions about social and environmental problems, while also maintaining a positive and solution-oriented outlook in the classroom. Kerret et al. (2020) investigated hope-enhancing programmes at schools in Israel, concluding that more research was required in terms of how to best design school activities to enhance environmental hope.

Action competence

While much research in environmental education attempts to measure specific pro-environmental behaviours, this study instead explores the more generalised and future-oriented concept of action competence. Action competence was developed by Danish environmental and health education researchers in reaction to shortcomings of both knowledge-based approaches that fail to achieve desired changes in behaviour and behaviour modification campaigns that manipulate students into choosing a set of predetermined pro-environmental behaviours (Jensen and Schnack 1997).

Action competence is defined as, 'a critical, reflective and participatory approach by which the developing adult can cope with future environmental problems' (Breiting and Mogensen 1999, 350). While the definition and utility of action competence continues to be debated, this approach to environmental and sustainability education relates to scientific literacy and self-efficacy (Bandura and Cherry 2020; Bishop and Scott 1998; Chawla and Cushing 2007; Mogensen and Schnack 2010; Sass et al. 2020). In developing a tool to measure self-perceived action competence for sustainability, Olsson et al. (2020) use a theoretical model with three components: knowledge of action possibilities, confidence in one's own influence, and willingness to act.

There is clear potential overlap between the sub-constructs of action competence and the dimensions of hope identified above, especially in terms of pathways and agency thinking, and the relationship between these two concepts is explored in more depth in this study. While Olsson et al. (2020) maintain a distinction between the concepts of hope and action competence when referencing Li and Monroe (2018) hope scale, Ojala (2015) recognises the similarities: 'there is a close relation between action competence and hope concerning global futures' (135). Li and Monroe (2018) also called for more research into the relationship between hope and action competence: 'Future research could also look at how the hope scale relates to climate change action competence among young people to find out whether this hope scale is a motivational force' (474).

Climate education

Article 12 of the UNFCCC Paris Agreement reinforces the importance of climate education as part of an agenda of action for climate empowerment (United Nations 2015). The education system has also been identified as a critical social tipping point for achieving the goals of the Paris Agreement to limit global warming (Otto et al. 2020). Improving climate education was a key recommendation of both the UK Climate Assembly and a summit of Education and Environment Ministers at the 26th Conference of the Parties to the UNFCCC (COP26) in Glasgow, as well as at a number of recent youth-driven events (Climate Assembly UK 2020; Finnegan 2021; Mock COP26 2021; United Nations 2021; Youth4Climate 2021).

As an emerging field of research and practice, there is still some debate about what constitutes good climate education (Reid 2019). A review of climate education research reported that, 'top-down, science-based approaches in formal educational settings [are] continuing to dominate the field of climate change education' while calling for an approach that 'empowers children and young people to meaningfully engage with entanglements of climate fact, value, power, and concern across multiple scales and temporalities' (Rousell and Cutter-Mackenzie-Knowles 2020, 12–13). Researchers in Finland have developed a new conceptual model of holistic climate change education using the metaphor of a bicycle, with the handlebars representing future orientation and the light attached to the handlebars representing hope and other emotions (Cantell et al. 2019). In a call to action that has been repeated by other researchers, Kagawa and Selby (2010) direct climate education towards the future: 'the learning moment can be seized to think about what really and profoundly matters, to collectively envision a better future, and then to become practical visionaries in realizing that future' (4–5).

In the UK, the youth-led *Teach the Future* campaign has crafted a climate education bill to update the national curriculum (Harvey 2022). Their recent survey of 4,690 secondary school

teachers in England found that only a third felt that climate change was meaningfully embedded in the curriculum for their subject (Teach the Future 2022). Another recent study of teachers in England found they supported interdisciplinary and action-oriented climate education (Howard-Jones et al. 2021).

Educators and learners who are calling for educational reform to improve climate education need to know how best to create meaningful educational experiences. This research picks up on that call with the goal of untangling the relationship between hope and action competence and exploring how teachers can educate for both.

Research questions

This study is part of a larger research project exploring how secondary schools in England are responding to the climate crisis and preparing young people for the future. The specific research questions driving this study are:

1. How can we better understand the future outlook of students by exploring their ratings of future scenarios, hope, distress, and action competence?
2. What is the relationship between teacher practices, the future outlook of students, and student participation in school sustainability activities and environmental protest?

Methodology

The research was approved by the Central University Research Ethics Committee (CUREC) at the University of Oxford, with reference number SOGE20201A-178.

Participants

In this study, 512 sixth form students and 69 secondary school teachers in England completed an online questionnaire delivered through Microsoft Forms. Sixth form is the traditional name for the final two years of secondary school in England, also known as Year 12 and Year 13, and the students ranged in age from 16 to 18 years old. The survey was conducted in 2021 and the majority of the participants were from twelve secondary schools in Greater London and the Thames Valley Region (Berkshire, Buckinghamshire, Oxfordshire), which were evenly split between state (government funded) and independent (privately funded) schools. The study used a combination of convenience sampling, recruiting schools based on geography and participation in networks related to sustainability, snowball sampling (as teachers were initially recruited in each school and they shared the questionnaire with their students and other teachers) and voluntary response sampling (as the survey respondents were recruited differently in each school, for example through a geography class, tutor group, or cross-curricular activities, and their participation was usually voluntary). Any submissions to the online survey that were outside England or outside the age range of 16 to 18 were excluded from this analysis.

Sixty-five percent of the students were in Year 12; during Year 13 students prepare for and take their A-Level exams (the sixth form leaving qualification), which most likely accounts for the smaller percentage. The breakdown of students by age was 26% 16, 52% 17, and 22% 18, with a mean age of 16.96. Sixty-seven percent of the students identified as female (three of the twelve secondaries were girls' schools), 1% chose the gender category 'other', and 2% withheld information about their gender. Seventy-eight percent of the students identified as white, which is slightly lower than the percentage of white 16-to-19-year-olds in England and Wales (82%) according to the 2011 Census

(Office for National Statistics 2021). The number of students that completed the survey was almost evenly split between state (51%) and independent (49%) schools, while only 13% of A-Level students in England attend independent schools (Department for Education 2021a). Table 1 is a cross-tabulation of the number of students by school type, gender and age.

In the analysis that follows, survey responses were compared across these identified subgroups (school type, age, gender, ethnicity) and are reported when statistically significant. In comparisons based on gender, 'other' and 'prefer not to say' were not included due to the small number in each category. The online survey did not capture the school name or any specific information about the school location, so no geographic comparisons can be made.

The teachers that responded to the survey are more heavily skewed towards independent schools at 71%. Ninety percent of the teachers identified as white, and 62% as female; for reference, the 2020 School Workforce Census of state schools in England found that 85% of teachers identified as white and 75% as female (Department for Education 2021b). The teachers in this study were a mix of new and experienced teachers: 28% were in their first five years of teaching, while a quarter had been teaching for more than 20 years, with a third of the teachers in their thirties and 29% in their fifties. The teachers represented a wide range of subjects: 48% STEM (science, technology, engineering, mathematics) more than half of which were biology and chemistry teachers, 33% humanities, and 14% social sciences, including geography.

Given the smaller sample of teachers, and the fact that it is heavily skewed towards independent schools, the analysis below doesn't break teachers into subgroups. The responses of teachers were compared to students, and reported below when statistically significant.

Questionnaire

Table 2 outlines the different sections of the questionnaire, including the number of questions, themes and calculations, sources, and whether they applied to students or teachers. The survey primarily used questions that were developed and validated through previous research, as indicated in the table below.

Recent studies have included more sophisticated surveys of climate anxiety, including cognitive and functional impairment, but these studies were published after this research began so did not influence the design of the questionnaire (Clayton and Karazsia 2020; Hickman et al. 2021). The questions about negative emotions were adapted from studies of participants in the 2019 school climate strikes (Wahlström et al. 2019; Wahlström et al. 2020). These responses were used to measure Climate Change Distress (CCD) based on the similar calculation by Searle and Gow (2010).

Future scenarios were adapted from the short narratives in Grund and Brock (2019). This section of the questionnaire included brief instructions to picture the world in 50 years and then rate each scenario in terms of likelihood and desirability. The positive climate scenario read:

The importance of climate change was recognised by all sectors of society. Curbing it has become top priority resulting in a stable Earth system.

The negative climate scenario was:

Climate change and its consequences could not be contained in time by an altering course in politics, business and individual behaviour. This led to severe ecological crises and to massive economic declines, as well as a severe decrease of quality of life for the majority of people.

The ratings of the likelihood of the positive and negative climate scenarios were used to calculate the Climate Change Scenario Rating (CCSR):

Positive scenario likelihood – negative scenario likelihood

The questionnaire also included an open-ended question for respondents to share their outlook on the future in three words. After cleaning up the responses (correcting misspellings,

Table 1. Cross-tabulation showing number of students by school type, gender and age.

	Female			Male			Other			Prefer not to say			All
	16	17	18	16	17	18	16	17	18	16	17	18	
Independent school	17%	36%	17%	7%	15%	5%	0%	<1%	<1%	<1%	<1%	1%	253
State school	19%	32%	14%	8%	19%	7%	0%	<1%	0%	0%	1%	0%	259
All	18%	34%	15%	7%	17%	6%	0%	<1%	<1%	<1%	<1%	<1%	512

combining variations of the same word, simplifying phrases), 59 words were coded as positive, 103 as negative, and 69 as neutral, and a network analysis was conducted on the words that were used together. Students also rated how actively they participated in school sustainability and environmental protest activities.

As noted in Table 2, the variation of the questionnaire for teachers did not include the questions on emotional support or outlook (in which students rated their teachers) and the two questions about student activities.

The data is available on the Oxford Research Archive for Data (<https://doi.org/10.5287/bodleian:kkZRkMBMy>). Both the full questionnaire, which includes some questions not included in this study, and a Jupyter Notebook of the data analysis (Python) are also available via the link above as related items.

When comparing mean values of scales for different segments of the research participants, only statistically significant comparisons are reported below, and data was tested for normality and variance. When indicating the strength of association from correlation analysis, the general guidelines of Campbell and Swinscow (2009) are followed: r of 0 to .19 is very weak, .2 to .39 is weak, .40 to .59 is moderate, .6 to .79 is strong and .8 to 1 is very strong.

Results

This section is organised based on the two research questions above, beginning with a descriptive analysis of student future outlook.

The future outlook of students: hope, action competence, distress, and future scenarios

To explore this first research question, we will look at the Climate Change Hope Scale (CCHS), Climate Change Distress (CCD) score, Climate Change Scenario Rating (CCSR) and Self-Perceived Action Competence for Sustainability Questionnaire (SPACS-Q). For each calculation, there is a statistically significant difference based on gender, which is presented in Table 3.

According to the CCHS, the students were slightly hopeful, with a mean score above 1 on a scale of -3 to 3, and 94% of students scoring above zero. Two-sided independent T-tests were used to compare CCHS scores of teachers and students, and different subgroups of students. Teachers were moderately more hopeful ($M=1.68$, $SD=0.75$) than students ($M=1.39$, $SD=0.76$); $t(579) = 2.97$, $p < 0.01$. Students that identified as female were more hopeful than students that identified as male (see Table 3). A one-way ANOVA calculated for the three age groupings also found statistical significance, with CCHS scores decreasing with age when comparing 16-year-olds ($M=1.57$, $SD=0.70$) to 17-year-olds ($M=1.30$, $SD=0.76$) and 18-year-olds ($M=1.39$, $SD=0.78$); $F(2, 509) = 5.53$, $p < 0.01$.

The Self-Perceived Action Competence for Sustainability Questionnaire (SPACS-Q) scores follow a similar pattern to CCHS. With respect to the mean scores on a scale of 1 to 5, teachers have a higher SPACS-Q scores ($M=3.86$, $SD=0.46$) than students ($M=3.61$, $SD=0.57$); $t(561) = -3.48$, $p < 0.001$. Students that identify as female rate higher than students that identify as male (see Table 3). Younger students have slightly higher scores when comparing 16-year-olds ($M=3.71$, $SD=0.53$) to 17-year-olds ($M=3.57$, $SD=0.56$) and 18-year-olds ($M=3.58$, $SD=0.62$); $F(2, 509) = 3.01$, $p < 0.05$.

Table 2. Questionnaire components.

	Number of questions	Themes/Calculations	Sample question	Source	Students/ Teachers
Hope	11	Climate Change Hope Scale (CCHS) and sub-scales personal-sphere will and way (PW), collective-sphere will and way (CW), lack of will and way (LW*)	<i>I am willing to take actions to help solve problems caused by climate change</i> (7-point Likert scale for agreement)	Li and Monroe 2018	Students and teachers
Negative emotions	7	Climate Change Distress (CCD)	<i>To what extent does climate change make you feel... Angry</i> (5-point Likert scale for magnitude)	Wahlström et al. 2020, Searle and Gow 2010	Students and teachers
Future scenarios	4	Climate Change Scenario Rating (CCSR)	Scenarios described below (7-point Likert scale for likelihood and desirability)	Grund and Brock 2019	Students and teachers
Feelings about the future	1	Open-ended question	<i>How do you feel about the future? Please use only three words.</i>		Students and teachers
Action competence	12	Self-Perceived Action Competence for Sustainability Questionnaire (SPACS-Q) and sub-constructs knowledge of action possibilities (KAP), confidence in own influence (COI), willingness to act (WTA)	<i>I believe I have good opportunities to participate in influencing our shared future</i> (5-point Likert scale for agreement)	Olsson et al. 2020	Students and teachers
Educator practices part 1	12	Teachers' accepting (AE) or dismissive (DE) attitudes toward students' negative emotions in response to societal and environmental issues, teachers' positive (PO) or negative (NO) outlook towards societal and environmental issues	<i>If I wanted to talk about negative emotions such as worry or anger in the face of a societal or environmental problem, there are teachers who would listen to me and take my emotions seriously</i> (5-point Likert scale for applicability)	Ojala 2015	Students
Educator practices part 2	5	Discussion of future orientation (FO) and pathways to sustainable development (SDP) in school	<i>How often have you had classes that dealt with... what I can do to influence our common future?</i> (4-point Likert scale for frequency)	Ojala 2015	Students and teachers
Student activity	2	School sustainability, environmental protest	<i>How often have you participated in... school sustainability efforts, such as an eco-club?</i> (4-point Likert scale for frequency)		Students

Note. LW is reversely coded

In the questionnaire, students also reported how much they felt a series of negative emotions with respect to climate change. Combining the 'quite' and 'very much' responses, the strongest feelings are anxiety (68%), worry (68%), frustration (67%), anger (58%), and fear (57%). The only emotions that a majority of respondents didn't strongly feel were powerless (48%) and hopeless (38%). These emotions were also used to calculate CCD, with Cronbach's alpha of 0.90 indicating high internal consistency. Students reported moderate levels of CCD, and students that identified as female had higher levels of CCD than students that identified as male (see Table 3). There also is a slight difference in distress reported by ethnicity, with students from ethnic minorities (excluding white minorities) reporting lower levels of CCD ($M=3.40$, $SD=1.08$) than white students ($M=3.68$, $SD=0.91$); $t(510) = 2.79$, $p < 0.01$.

A fourth reference point was provided by the ratings of the likelihood and desirability of positive and negative climate change scenarios adapted from Grund and Brock (2019). A Pearson correlation of responses to both climate scenarios finds a negative relationship between likelihood and desirability for students ($r=-.360$, $p < 0.001$) and teachers ($r=-.348$, $p < 0.001$) which indicates they have a negative view of the future – desirable scenarios are rated as less likely, undesirable scenarios are rated as more likely. Looking more closely at the likelihood ratings on a scale of 1 to 7, the students rated the negative scenario ($M=4.82$, $SD=1.36$) as more likely than the positive scenario ($M=3.76$, $SD=1.44$). A similar pattern exists between the teacher ratings of the likelihood of the negative scenario ($M=5.03$, $SD=1.28$) versus the positive scenario ($M=3.65$, $SD=1.62$). As explained above, we can also subtract the negative scenario likelihood from the positive scenario to calculate the CCSR, and the majority of both students (59%) and teachers (61%) had a negative outlook. The only statistically significant difference on CCSR values is based on gender, with students that identify as female having slightly more negative outlooks than students that identify as male (see Table 3).

The relationship between climate hope and action competence

Given the similarities between the conceptual frameworks, questionnaires, and descriptive results for the measurements of climate hope and action competence, this relationship was further investigated. Table 4 presents the Pearson correlation coefficients for the student scores for CCHS, SPACS-Q, and their respective subscales. This analysis indicates a very strong correlation between the two scales ($r = .648$, $p < 0.001$), which means that the more the students have hope about climate change, the more probable it is that they also have a high rating of

Table 3. Climate hope, distress, scenario ratings, and action competence of students, compared by gender.

	All		Female		Male		t-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
CCHS (–3 to 3)	1.39	0.76	1.49	0.64	1.19	0.93	4.24	< 0.001
CCD (1 to 5)	3.62	0.96	3.87	0.80	3.07	1.02	9.47	< 0.001
CCSR (–6 to 6)	–1.06	2.08	–1.20	2.02	–0.68	2.14	–2.62	< 0.01
SPACS-Q (1 to 5)	3.61	0.57	3.72	0.51	3.39	0.63	6.01	< 0.001

Note. CCHS = Climate Change Hope Scale, CCD = Climate Change Distress, CCSR = Climate Change Scenario Rating, SPACS-Q = Self-Perceived Action Competence for Sustainability Questionnaire

Table 4. Pearson correlation coefficients (*r*) for student climate hope, action competence, and subscales.

	CW	PW	LW	CCHS	KAP	COI	WTA	SPACS-Q
CCHS	.801***	.749***	.764***	1	.429***	.577***	.541***	.648***
SPACS-Q	.420***	.683***	.445***	.648***	.731***	.821***	.828***	1

Note. *** $p < 0.001$, CW = collective sphere willpower and waypower, PW = personal-sphere willpower and waypower, LW = lack of willpower and waypower, CCHS = Climate Change Hope Scale, KAP = knowledge of action possibilities, COI = confidence in one's own influence, WTA = willingness to act, SPACS-Q = Self-Perceived Action Competence for Sustainability Questionnaire

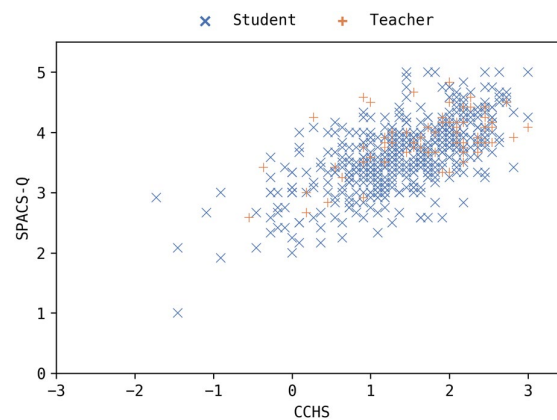


Figure 1. Student and teacher scores for the Climate Change Hope Scale (CCHS) and Self-Perceived Action Competence for Sustainability Questionnaire (SPACS-Q).

self-perceived action competence. This relationship is illustrated in [Figure 1](#). The strongest correlation across the two scales is between the overall SPACS-Q score and the personal-sphere willpower and waypower (PW) component of CCHS scale ($r = .683, p < 0.001$).

This exploration of the relationship between climate hope and action competence, as reflected in CCHS and SPACS-Q, was motivated by the similar conceptual framework of the two measures and potentially overlapping questions. This strong correlation between SPACS-Q and both overall CCHS and the PW component of CCHS indicates that action competence is strongly related to the personal dimension of climate hope.

Feelings about the future

In addition, we can explore both positive and negative emotions through responses to the open-ended question: *How do you feel about the future? Please use only three words.* Five words appeared in over 10% of the student responses: hopeful (30%), scared (15%), excited (14%), worried (13%) and uncertain (12%). The phrases were coded to indicate if the overall sentiment was positive, negative, neutral or mixed. 36% of the student responses were mixed – including both positive and negative words – while 35% were negative, 19% were positive, and 10% were only neutral words. It is worth noting that earlier references to climate hope describe a cognitive concept, as reflected in Snyder's hope theory and the Climate Change Hope Scale, however the student responses of 'hopeful' for this question can be understood as a positive emotional response.

A matrix of co-occurring words was used to visualise these responses as a network, with individual words as 'nodes' and co-occurring pairs as 'edges' (the connections between nodes). The most common combinations were hopeful and scared (5%), hopeful and worried (5%), hopeful and uncertain (5%), and hopeful and excited (3%). For readability, the Gephi network visualisation in [Figure 2](#) only includes words that were repeated at least 5 times, and the proportional size of nodes is not to scale.

The young people in this study have mixed emotions about a future shaped by climate change and our response to the climate crisis. With respect to measures of hope, they are moderately hopeful about the future; teachers appear to be more hopeful than their students, students that identify as female are more hopeful than students that identify as male, and younger students are more hopeful than older students. Students also report worry, anxiety, frustration, anger and fear about the future, and are moderately distressed about climate change,

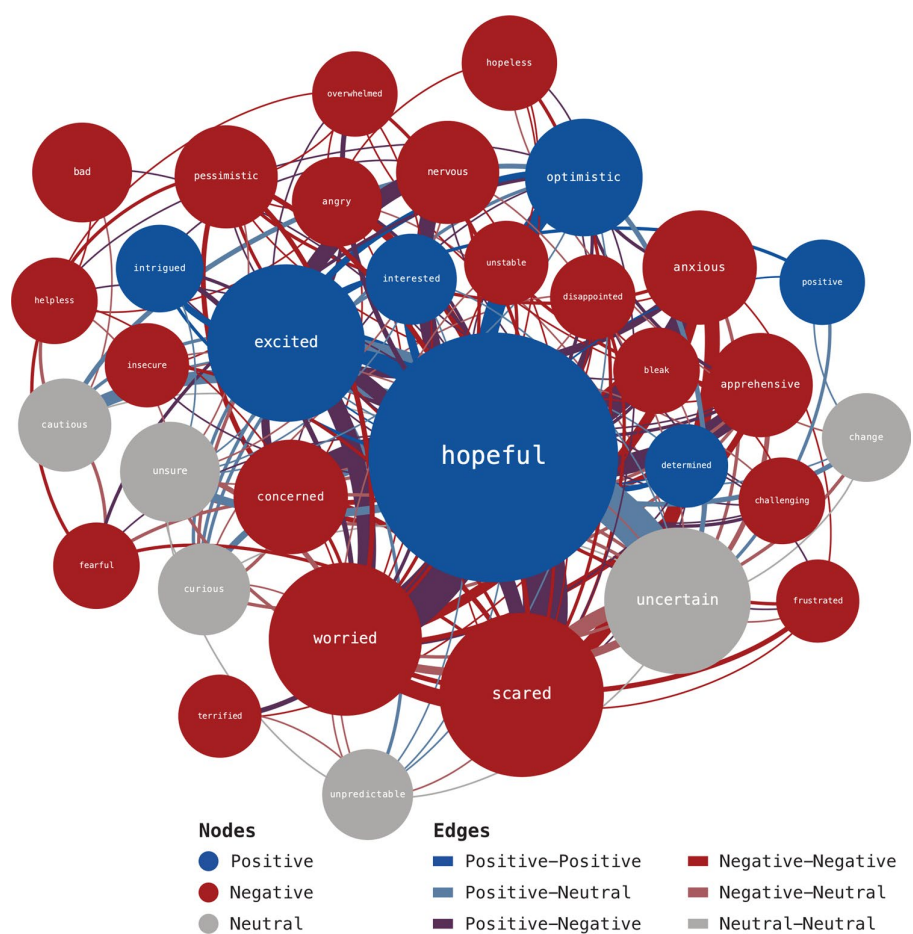


Figure 2. Network of co-occurring words in response to the open-ended question: *How do you feel about the future? Please use only three words.*

with students that identify as female more distressed than students that identify as male, and white students more distressed than ethnic minorities. Both students and teachers rated a negative future scenario which would lead ‘to severe ecological crises and to massive economic declines, as well as a severe decrease of quality of life for the majority of people’ as more likely than a positive climate scenario.

Teacher practices, the future outlook of students, and student participation in school sustainability activities and environmental protest

The components of the questionnaire related to teacher practices allow us to investigate the second research question. The results of four of these measures indicated statistically significant differences by school type, which are presented in Table 5.

Students reported that teachers were more likely to be accepting of negative emotions regarding societal and environmental issues ($M=3.37$, $SD=0.92$) than dismissive ($M=2.04$, $SD=0.89$). Students also reported that their teachers were more likely to maintain a positive and solution-oriented outlook in the classroom ($M=3.20$, $SD=0.89$) than a negative outlook ($M=2.29$, $SD=0.92$). Teachers rated their instruction as more oriented to the future ($M=2.56$,

Table 5. Student perception of teacher emotional support and outlook, and teaching about the future and sustainable development pathways, compared by school type.

	All		State		Independent		t-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
AE (1 to 5)	3.37	0.92	3.22	0.90	3.53	0.92	−3.92	< 0.001
PO (1 to 5)	3.20	0.89	2.88	0.87	3.53	0.79	−8.86	< 0.001
FO (1 to 4)	2.17	0.74	1.96	0.67	2.39	0.74	−6.84	< 0.001
SDP (1 to 4)	2.51	0.75	2.35	0.75	2.68	0.72	−5.08	< 0.001

Note. AE=accepting emotions, PO=positive outlook, FO=future orientation, SDP=sustainable development pathways

Table 6. Pearson correlation coefficients (*r*) for teacher practices and student climate change hope and action competence.

	AE	DE	PO	NO	FO	SDP
CCHS	.293***	−.164***	.250***	−.139**	.061	.131**
SPACS-Q	.371***	−.042	.357***	.032	.174***	.212***

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, AE=accepting emotions, DE=dismissing emotions, PO=positive outlook, NO=negative outlook, FO=future orientation, SDP=sustainable development pathways, CCHS=Climate Change Hope Scale, SPACS-Q=Self-Perceived Action Competence for Sustainability Questionnaire

Table 7. Mean values (and standard deviation) of student self-reported participation in school sustainability and environmental protest by school type and gender.

	State school		Independent school		All
	Female	Male	Female	Male	
School sustainability	1.86 (1.03)***	1.47 (0.84)***	2.43 (0.99)***	2.00 (1.11)***	2.01 (1.05)
Environmental protest	1.72 (0.92)***	1.29 (0.61)***	2.12 (1.01)***	1.53 (0.91)***	1.76 (0.96)

Note. *** $p < 0.001$, the gender categories 'Other' and 'Prefer not to say' have been left out of this analysis

Table 8. Pearson correlation coefficients (*r*) for school sustainability, environmental protest, hope, action competence, distress, future outlook.

	CCHS	SPACS-Q	CCD	CCSR
School sustainability	.258***	.378***	.243***	.002
Environmental protest	.208***	.340***	.360***	−.090*

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, CCHS=Climate Change Hope Scale, SPACS-Q=Self-Perceived Action Competence for Sustainability Questionnaire, CCSR=Climate Change Scenario Rating

$SD=0.68$) than students rated their teachers ($M=2.17$, $SD=0.74$); $t(579) = 4.11$, $p < 0.001$. Bringing together these teacher practices with CCHS and SPACS-Q, Table 6 shows the results of a Pearson correlation analysis.

The teacher practices that had the strongest correlation with student-reported climate hope were accepting negative emotions expressed by students and maintaining a positive and solution-oriented outlook in the classroom. This relationship is even stronger with respect to action competence – implying that teachers that accept negative emotions and maintain a positive outlook are more likely to have students with higher levels of both climate hope and action competence. These results also indicate differences based on school type, with all four positive teacher practices reported more strongly at independent schools than at state schools.

Turning to self-reported student action, rather than ask about specific pro-environmental behaviours, the questionnaire included more general questions about student participation in school sustainability activities, like an eco-club, and environmentally-themed protests, such as the Fridays for Future climate strikes.

43% of students reported that they had never participated in school sustainability activities and 56% had never participated in environmental protests. This also means that the majority of students have participated to some extent in school sustainability activities and a large

percentage have attended at least one environmental protest. Table 7 presents the mean values of the student responses using the four-point frequency scale – never (1), seldom (2), sometimes (3), often (4) – grouped by school type and gender. Table 8 presents a Pearson correlation analysis of these student activities and the hope, distress, competence, and future orientations scores.

This finding confirms the basic premise of action competence – higher levels of self-perceived action competence translate to higher frequencies of environmental action. The impact of climate hope and distress on action appears to be more complicated, as the strongest correlation for protest activity was with climate distress, while school sustainability activity was more strongly correlated with hope than distress. Of course, the causality of these relationships is not clear, as climate hope, for example, could be interpreted as motivating school sustainability activity, or participation in school activities might engender climate hope. The scenario rating, which reflects student assessments of the likelihood of a positive climate future, does not appear to have any relationship with environmental action.

Education for climate action mediated by the future outlook of students

Further investigating the relationship between teacher practices, student outlook, and action, a model in which both climate hope and distress were analysed as mediators between teacher practices and student action was developed. Maintaining a positive and solution-oriented outlook was the teacher practice most strongly correlated with student participation in both school sustainability ($r = .317$; $p < 0.001$) and environmental protest ($r = .249$; $p < 0.001$) and was used as the independent variable in this model, with both student activities as the dependent variables, and climate hope and distress serving as mediators (see Figure 3). In terms of the other elements of future outlook described above, the scenario rating did not have strong enough relationships with the dependent or independent variables to be included as a mediator, and action competence and climate hope were too closely correlated to include both as mediators.

The mediation analysis was conducted by calculating the ordinary least squares linear regression to identify the relationships between the different variables in the model. The β coefficient from linear regression between teacher positive outlook and student participation in school sustainability activities is 0.38 (c in Figure 3), which means an increase in the positive outlook score by 1 predicts an increase in school sustainability activity by 0.38 ($p < 0.001$). The adjusted R^2 , or coefficient of determination, for this relationship is 10%, indicating that 10% of the variation in student school sustainability activity can be explained by this relationship with teachers' positive outlook.

Next, linear regression was calculated between the independent variable and both mediators (a_1 and a_2 in Figure 3), and between both mediators and the dependent variable (b_1 and b_2 in Figure 3). The indirect or average causal mediation effect is the product of the β coefficient for each of these moderators ($a_{\#} \times b_{\#}$) which was 0.05 for hope and 0.03 for distress. When included in the model, these indirect effects decrease the direct prediction by teacher practice to 0.30 (c' in Figure 3) while increasing adjusted R^2 to 16%, meaning the inclusion of the mediating variables of climate hope and distress increased the predictive power of the model.

Performing the same calculations with the dependent variable as environmental protest, the β coefficient decreased from 0.27 to 0.20 ($p < 0.001$), with the indirect effect from hope equal to 0.03 and the indirect effect from distress equal to 0.04, and adjusted R^2 increased from 6% to 18%. The mediation model was run with 10,000 bootstrap iterations for the confidence intervals and p -value estimations.

This mediation analysis indicated that climate hope and distress contribute to the relationship between teacher practices and student action, with hope playing a larger role in motivating school sustainability activity and distress playing a larger role in environmental protest activity.

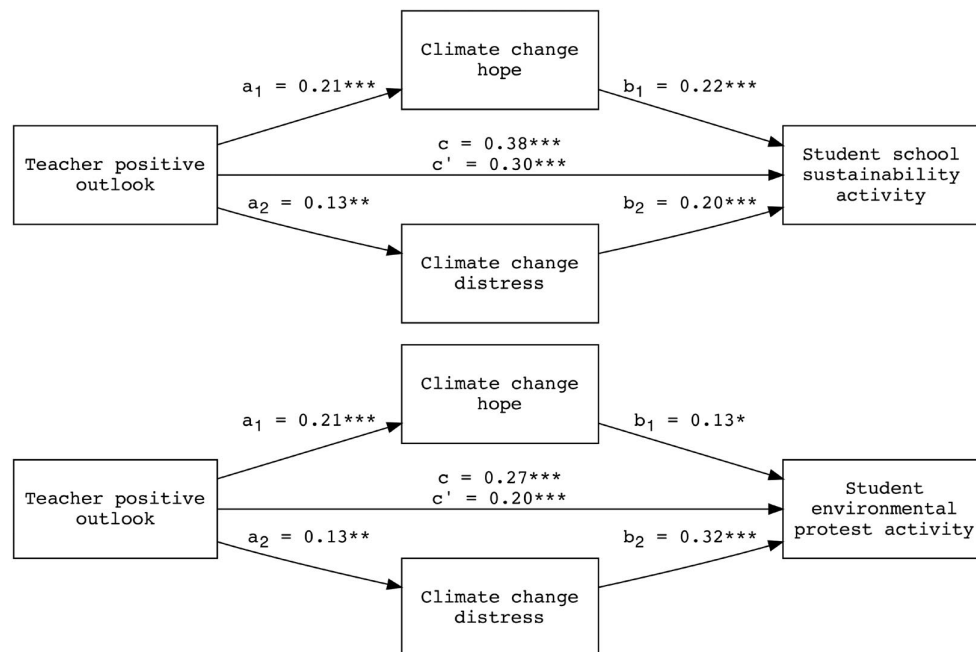


Figure 3. Mediation analysis diagram of the impact of teachers' positive and solution-oriented outlook on both students' school sustainability and environmental protest activity, mediated by climate hope and distress. Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

It is important to note that cross-sectional data is used to test this theoretical model in terms of these relationships. Future longitudinal and experimental research would be required to confirm these relationships and the direction of influence or causality.

Discussion

This study set out to triangulate the assessment of climate hope among sixth form students in England with ratings of the likelihood and desirability of positive and negative future scenarios, as well as negative emotions captured by climate change distress. Students had moderately high levels of both hope and distress, and negative future outlooks. Mixed emotions towards the future were also reflected in the network analysis of the open-ended response capturing their feelings about the future. While the pessimism reflected in the ratings of future scenarios appear to contradict the findings of moderately high levels of hope, these results may actually reflect an aspect of hope – one can maintain a high level of hope that a positive outcome is possible while still believing that a negative outcome is more likely than a positive outcome. Also worthy of note is that students that identified as female had higher ratings of both climate hope and climate distress compared to students that identified as male, although researchers have identified similar gender differences in young people's emotional expression beyond environmental issues (Chaplin and Aldao 2013).

In addition, this study used recently developed and validated scales for hope and action competence to explore the relationship between these concepts. As noted above, there was a strong positive correlation between hope and action competence, as captured by Climate Change Hope Scale (CCHS) and Self-Perceived Action Competence for Sustainability Questionnaire (SPACS-Q). When extending this analysis to the sub-components of each scale, there was a

strong positive correlation between the overall SPACS-Q score and the personal-sphere willpower and waypower subscale of CCHS. Given the similar conceptual frameworks and questions used in each scale, this association is not unexpected, but it does indicate a strong relationship between the personal dimension of climate hope and the concept of action competence.

Another concern of this study is what teachers can do in the classroom to support hope and action competence in their students. Replicating research with Swedish teenagers (Ojala 2015), this study found a positive correlation in England between student hope and teachers accepting negative emotions and maintaining a positive and solution-oriented outlook with respect to social and environmental problems. This correlation is notable as the original study did not use the CCHS to assess hope, indicating a durable relationship between these practices and the concept of climate hope. Future research could investigate a more extensive series of teacher practices (beyond the six measures identified in Table 2 in the rows labelled educator practices part 1 and 2) developed in collaboration with educators, resulting in practical guidance for climate education.

The questions related to teaching practices also revealed a potential divide between independent schools and state schools, as the students at independent schools reported higher levels of future orientation, sustainable development pathways, positive outlook, and acceptance of negative emotions. There were no significant differences between students from state and independent schools when it came to their responses for hope, distress, future scenarios, and action competence. Private education has been identified as a major factor perpetuating educational inequality in the UK (Farquharson, McNally, and Tahir 2022). Independent schools have more flexibility in the classroom, as they are not required to follow the national curriculum of England, and have more resources – an average of £6,500 more per pupil per year compared to state schools – which helps explain the higher ratings of teacher practices in this study. Given the differences between privately-funded and government-funded education, as well as the differences in class and socio-economic privilege of the respective student populations, the similarities in the cognitive and emotional scores for students across school types is notable and worthy of additional research. In addition, the schools included in this study were based in Greater London and Southeast England, and future research could compare students and teachers from different regions of the United Kingdom.

While hope and action competence are oriented to the future, this study also explored the relationship between these two concepts and climate action today. Action competence, as measured by the SPACS-Q, was one of the main predictors of reported participation in both school sustainability activities and environmental protests. Distress was more likely to predict participation in environmental protests. Hope was an additional predictor of participation in school sustainability activities. In an attempt to weave together teacher practices, climate hope and distress, and student action, this research included the development of a model of emotionally-mediated education for climate action. While the model only partially explained the relationship between the independent variable of teacher positive outlook and dependent variables of student sustainability activities, the mediation analysis confirmed that emotions have a mediating effect, with the indirect effect of climate change hope being larger than climate change distress when motivating school sustainability activity. The opposite is true of environmental protest activity – climate change distress has a larger average causal mediation effect than climate change hope. As this is only cross-sectional data, these results should be interpreted as a preliminary test of the model, and longitudinal or experimental studies would be required to confirm this causality.

Hope is often conceived of as in opposition to – or a remedy for – anxiety when it comes to climate change. However, a more complicated picture emerged from this research in which hope and distress coexist, and both have a relationship with environmental action. Studies of public health campaigns utilising fear appeals have identified an important relationship between threat and efficacy when it comes to message effectiveness, and this may also be true of

emotionally-mediated climate education (Peters, Ruiter, and Kok 2013; Tannenbaum et al. 2015). The lack of a relationship between future outlook, as captured by the future scenarios, and environmental action may also indicate that pessimism about the distant future is somewhat universal, as both hopeful and hopeless students (as well as both students participating in climate action and those not participating) believe a negative future is more likely than a positive one. Future research into both climate hope and anxiety could provide important insights into the complex interactions between anxiety and hope for the future, and how these translate into, and are shaped by, climate action.

There are a number of limitations to this study. The questionnaire for this study was distributed during a school year disrupted by the COVID-19 pandemic, when lockdowns, online learning, and disruptions to school activities and exams may have impacted the young people's perceptions of the future. The impact of the pandemic on young people may have resulted in more negative outlooks, and the long-term relationship between the pandemic and youth climate attitudes and action is worthy of additional research. However, interest in and concern about climate change may have remained high during the pandemic, especially as this study was preceded by a new wave of youth climate activism and followed by the high profile COP26 events in the UK.

The online questionnaire did not track the individual schools, which made it impossible to know the response rate for each school, or the specific number of respondents outside the twelve schools with which the researcher directly communicated. While the students were evenly split between state and independent schools, this does not reflect the proportion of sixth form students in privately funded education in England, which is only 13%. The students were also not demographically representative of young people in England in terms of gender; two-thirds of the students identified as female, as a number of the schools engaged in the research were girls' schools, and students that identify as female may have been more likely to choose to participate in the research. 3% of the students chose the gender category 'other' or withheld information about their gender, and these students aren't included in the analysis by gender above. The combination of convenience, snowball and voluntary response sampling limit the strength of the results, as students with higher levels of interest in climate may have been more likely to complete the survey.

Finally, in terms of the findings of this study, the strong correlation between climate hope and action competence can be explained by the similar conceptual models and questionnaires, and therefore is not a particularly surprising result. And, as noted above, the mediation model uses cross-sectional rather than longitudinal or experimental data, and therefore cannot be used to confirm causal relationships.

Conclusion

The cognitive and emotional landscape of climate change is complicated, especially for young people looking ahead to a future shaped by this issue. As the model of emotionally-mediated education for climate action illustrates, hope and distress are both fuelling climate action of different sorts, and both may be necessary to respond to this time of crisis and shape a positive future.

In this study, previously developed and validated surveys were used to further investigate the relationship between hope and action competence (Li and Monroe 2018; Olsson et al. 2020). Any future development of these questionnaires would benefit both from integrating these two survey instruments and by incorporating additional concepts such as collective action competence and positive reappraisal (Clark 2016; Ojala 2012). A comprehensive tool that assesses both hope and distress, especially cognitive and functional impairment as a result of climate anxiety, would be invaluable to better understand the complicated relationship between climate hope, distress and action (Clayton and Karazsia 2020). In terms of climate action, this study had a novel focus on exploring how young people collectively participate in systems change in their schools and communities, rather than just exploring individual pro-environmental actions.

For teachers, this research replicated the finding that accepting negative emotions and maintaining a positive outlook correlates with students expressing climate hope. It is worth noting the importance of both of these practices – educators that aspire to maintain a positive outlook when teaching about climate change should take care not to dismiss the negative emotions that students might express in the classroom. Emotional support provided by teachers is an emerging theme in environmental and climate education research and practice (O'Hare et al. 2020; Ojala 2021). Teachers should also actively engage young people in talking about the future that they want and how they can shape it, as this is not currently happening despite calls for futures literacies by researchers and interest from students (Hicks and Holden 1995; Facer and Sriprakash 2021).

Constructive hope can be understood as a stance towards the future in which we believe a positive future is possible, but not a given, and each of us are called to shape that future. That is where action competence comes in, as it represents the skills and competencies required to navigate future challenges and act sustainably. Teachers who want to support hope should look to the long tradition of action competence in environmental education, which has a strong relationship with the personal dimension of climate hope. Educating for hope and action competence involves engaging young people with the future, creating space for them to express the negative emotions generated by the climate crisis, and maintaining a positive and solution-oriented outlook in the classroom. The climate resilience of young people involves experiencing both climate hope and distress, and harnessing these cognitive and emotional responses for action. Educators play an essential role in supporting young people as they develop this resilience and maintain constructive hope.

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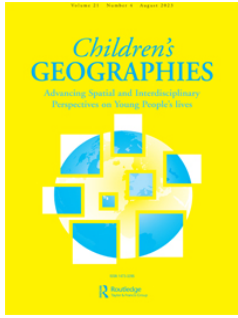
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5

‘It’s beautiful, living without fear that the world will end soon’ – digital storytelling, climate futures, and young people in the UK and Ireland

This article was submitted on 6 June 2022 to the journal *Children’s Geographies*, accepted for publication on 21 November 2022, and published online as an open access article on 10 December 2022. The peer review process included two reviewers, one of whom encouraged me to use a more creative article structure, resulting in the sections based on a storytelling structure used by the StoryCenter: connection, context, change, closure. This article investigates similar themes to the previous chapter, but through a very different methodology grounded in creative, participatory research. The digital storytelling process built upon my master’s thesis which incorporated youth participatory video, professional experience in digital environmental communication, and training I received from the StoryCenter during my doctoral studies. The students involved in the digital storytelling workshops controlled whether their videos were not be shared outside the research process, shared anonymously, or shared with attribution, and a playlist of their ‘letters from the future’ as well as an animation produced with multiple student voices are available at: <https://tinyurl.com/lettersfrom2050>.

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'It's beautiful, living without fear that the world will end soon' – digital storytelling, climate futures, and young people in the UK and Ireland

William Finnegan

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RESEARCH ARTICLE

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'It's beautiful, living without fear that the world will end soon' – digital storytelling, climate futures, and young people in the UK and Ireland

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ABSTRACT

This research explores two questions: how do young people imagine futures shaped by climate change and our collective response to the climate crisis, and what is the impact on young people of creatively engaging with the future? The participatory action research method of digital storytelling was adapted to explore climate futures, with thematic, visual and narrative analysis of the resulting videos. Young people articulated positive, negative and more complicated visions of the future, including counterfactuals, discontinuities, and living with loss and change. They also described a process of positive reappraisal over the course of the speculative digital storytelling workshops, with emotions about the future shifting from being predominantly negative to a more balanced spectrum including acceptance, curiosity and hope.

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KEYWORDS

Climate change; digital storytelling; futures; youth

Connection

*Hey, it's you, or me. Same thing. This might confuse you, but I'm you from the future. I'm writing this from 2050. Things have changed so quickly.*¹

In September 2019, an estimated six million people participated in the Fridays for Future climate strikes around the world (Taylor, Watts, and Bartlett 2019). In London, where the author joined the strikers with his children, a sea of protesters gathered near the Houses of Parliament. Young people and their supporters demanded climate action through homemade signs: 'There is no planet B', 'You'll die of old age, we'll die of climate change', 'My future is in your hands'.

In an early review of research on the school climate strikers, Bowman reflected on the imagination of young people as they look into an uncertain future: 'Climate action is more than protest: it is also a world-building project, and creative methodologies can aid researchers and young climate activists as we imagine, together, worlds of the future' (2019, 296). This research picks up on that call, collaborating with young people to explore their hopes and fears for the future through digital storytelling. This research also responds to interest in the fields of Children's Geographies and Childhood Studies in the everyday climate activism of young people, which is shaped by their perceptions of the future (Skovdal and Benwell 2021; Spyrou, Theodorou, and Christou 2022).

Building on the traditions of participatory action research and more recent developments in narrative, visual and digital analysis, this article explores two interconnected research questions:

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- How do young people in the UK and Ireland that are engaged with climate activism imagine futures shaped by climate change and our collective response to the climate crisis?
- What is the impact on young climate activists of creatively engaging with the future?

These questions are particularly relevant to climate educators interested in helping young people develop both resilience amid change and the skills to shape the future. Speculative digital storytelling is a novel participatory research method and promising environmental education practice, with the potential to offer new insights into youth perspectives on climate change while supporting young people's positive reappraisal of environmental problems.

Context

Should I tell you what the world will be like 30 years from now? Well, it can go in two ways.

Imagining climate futures

Futures are of interest across the social sciences. Mische (2009) called for a 'sociology of the future', arguing that cultural sociologists should pay as much attention to future projections as they do to collective memories. In science and technology studies, Jasanoff defined sociotechnical imaginaries as: 'collectively held, institutionally stabilised, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology' (2015, 4). Levy and Spicer (2013) identified four different climate imaginaries: fossil fuels forever, climate apocalypse, techno-market and sustainable lifestyles. Milkoreit extended this thinking into the concept of socio-climatic imaginaries, which incorporate both social and natural systems, as well as undesirable and mixed possible futures (2017). At the level of individuals and human psychology, Andrews described the combination of imagination and narrative as, 'a bridge traversing the pathway between what is known, and what can be known, between the present and possible futures' (2014, 5).

Futures thinking also has practical applications. In Japan, a Future Design movement has emerged in which people represent imaginary future generations in planning discussions, with the aim of 'activating a human trait called *futurability*, where people experience an increase in happiness because of deciding and acting to forego current benefits in order to enrich future generations' (Saijo 2020, 2). In Wales, the Well-being of Future Generations Act of 2015 established a Future Generations Commissioner to advise government bodies on sustainable development and the long-term impacts of their decisions (National Assembly for Wales 2015). The Swedish Narrating Climate Futures initiative, which is part of the Climagaries network, created *The Museum of Carbon Ruins*, an immersive, speculative exhibition presenting a post-carbon 2053 (Raven and Stripple 2020). Reflecting on a collaboration between artists and academics exploring climate futures in Spain and Portugal, Galafassi et al. concluded, 'visioning then is not something one does once and for all (as in forming an image), but rather it is a continuous process of making the future present in order to discover preferences towards certain futures and taking actions in the present towards an evolving purpose' (2018, 8).

Environmental and sustainability educators have long argued for developing futures literacies, with Hicks and Holden contending, 'probable and preferable futures, scenarios, envisioning, can fruitfully be employed in the classroom to help students develop a futures perspective' (2007, 509). Examples of creative engagement with climate futures include digital storytelling (Cunsolo Willox, Harper, and Edge 2013), participatory video (Haynes and Tanner 2015; Littrell et al. 2020; Walsh and Cordero 2019), photovoice (McKenzie and Bieler 2016; Trott 2019) and speculative fiction (Doyle 2020; Rudd, Horry, and Lyle Skains 2020). With respect to these 'inventive methodologies', Coleman has argued that, 'a sensory sociology of the future might be interested not only

in *documenting* orientations or imaginations of the future, but also in *probing, provoking, stimulating* them' (2017, 539).

Climate and other environmental campaigners have been characterised as using apocalyptic imagery to motivate action, reflecting a form of future-oriented pessimism (Cassegård and Thörn 2018). Amid debates about the effectiveness of positive versus negative rhetoric, a new form of post-apocalyptic environmentalism has emerged – represented by Extinction Rebellion, Deep Adaptation and the Dark Mountain Project – that anticipates a future characterised by irreversible and unavoidable loss (Cassegård and Thörn 2018; Moor 2021; Friberg 2021).

Recent research has also found high levels of climate anxiety among young people, with students rating negative climate scenarios as more likely than positive climate scenarios (Finnegan 2022; Hickman et al. 2021). Advocating for participatory methods and arts-based engagement with young people on climate, Trott commented, 'the arts can support critical reflection and creative expression, allowing young people to envision alternative and preferable futures and how to get there (i.e. helping us to imagine "what if?")' (Trott 2021). Verlie takes the power of story a step further in terms of how we can learn to live with climate change: 'We need stories that enable us to identify as *part of* climate change, and that enable us to stay with the ethical and interpersonal challenges of *living with it*' (2022, 104).

Digital storytelling in research

Digital storytelling, as reflected in the International Digital Storytelling Conference, is rooted in the community arts work of the American charity StoryCenter (StoryCenter n.d.). This model of storytelling involves a facilitated workshop in which people without any filmmaking experience produce short, first-person, multimedia narratives. Digital storytelling has been adopted in a variety of educational, organisational, and developmental contexts, including the Patient Voices programme in the UK (Hardy and Sumner 2018).

A systematic review of digital storytelling in research confirmed its contribution as a participatory, sensory, visual research method, especially as the visceral nature of multimedia stories 'capture sensory data not accessible via written word or interview' (Jager et al. 2017, 2574). Hogan and Pink argue that visual methodologies involving creative expression are also a means of accessing the interior world of affect, or interiority, through a 'paradigm that views inner states as being in progress, rather than ever static' (2012, 233). After leading a digital storytelling project that shared the voices of older people in rural England living more sustainably, Gearty concluded, 'narrative and storytelling can play an important role in both action research and action learning by helping individuals not only learn through the telling of their own stories but also through their engagement in the stories of others' (2015, 160).

Narrative and visual turns

This research project builds on *turns* in social science towards narrative and visual analysis. While the visual research methods explored by Rose primarily relate to found images and visual culture rather than research that involves the production of visual material by research subjects, her criteria for critical visual methodologies are useful reference points: 'one that thinks about the agency of the image, considers the social practices and effects of its viewing, and reflects on the specificity of that viewing by various audiences, including the academic critic' (2016, 17).

With narrative analysis, Riessman (2008) argues that we are able to better understand the structure of stories and intention of storytellers by treating an entire narrative as an analytical unit, rather than coding small excerpts of text (or transcripts) out of context. Reflecting on the combination of narrative and visual turns in human sciences, Riessman commented, 'the power of the camera is turned over to research participants to record images they choose, and to story their meanings collaboratively with investigators' (2008, 143).

Participatory visual methods allow research subjects to express multiple and ambiguous narratives related to identity (Ní Ní Laoire 2016). Digital storytelling has also been described as a ‘more-than-visual’ method: ‘Rather than focusing on the image as data, more-than-visual methods take visual production as a situated, material, and embodied practice’ (Marshall, Smaira, and Staeheli 2022). As such, digital storytelling methods provide insights through both the production process and resulting stories into the provenance, properties, meanings and affordances of multimedia data.

Methodology

Forty-seven secondary school students in the United Kingdom and Republic of Ireland produced digital stories through this research project. The students attended upper secondary school and were between 15 and 18 years old. Participants were primarily recruited through the UK and Irish Schools Sustainability Networks, which emerged in 2020 to support teachers and students engaged in school sustainability activities after the youth climate strikes. The researcher also conducted workshops with small groups of students at two schools in London, two schools in Berkshire, and a museum in Oxford. Twenty-eight of the students attended independent schools, eighteen attended state schools, and one was home-schooled. Demographic information was not collected during the workshops. The researcher observed that approximately two-thirds of the participants were female and one-quarter were from ethnic minorities (excluding white minorities), while recognising that there are limitations to observed aspects of identity. The research was approved by the Central University Research Ethics Committee (CUREC) at the University of Oxford, with reference number SOGE20201A-178.

In advance of the research, the researcher participated in StoryCenter’s certification programme for facilitators. Digital storytelling workshop materials were adapted to include information about climate science, climate change communication, and future scenarios (Climate Lab Book *n.d.*, Climate Outreach 2020, Great Transition Initiative *n.d.*). As a vehicle for first-person, multimedia expression, digital storytelling tends to be a reflective process, in which the storyteller identifies and explores ‘the moment of change that best represents the insight they wish to convey’ (Lambert and Brooke Hessler 2020, 71). In this research, storytelling was speculative rather than reflective, with the participants encouraged to envision the world in the year 2050 and write a letter from their future self to the current self. These *letters from the future* were shared within each group of storytellers, and then recorded as narration for their videos.

The facilitated digital storytelling workshops were delivered by the researcher both in-person (25% of stories) and online (75% of stories) due to COVID-19 restrictions. The two-day in-person workshop was adapted into a series of virtual sessions, which were conducted during school lunch breaks, after-school, and at the weekend. The researcher obtained an educational licence for the browser-based software WeVideo, which the participants used to edit their videos. Each workshop concluded with a screening of the participants’ digital stories and a focus group conversation. At the end of the workshop, participants also revisited informed consent, especially with respect to how they wanted to share their digital stories (do not share, share anonymously, share with attribution). For consistency, all stories are referred to below using an anonymous code from DS01 to DS47 and focus group conversations use a code W1 to W8 for each series of workshops.

The 47 digital stories are the primary data generated during this research. The narration was transcribed and the researcher also created a list of the visuals used in each video, with notes about music and editing style. The focus group conversations were also recorded and transcribed. Eleven videos were used in public engagement activities connected to COP26, and creators of these digital stories each wrote a short filmmaker statement, which are considered supplemental data. These files were coded in NVivo for reflexive thematic analysis, in terms of themes identified in both the audio and visuals of the stories, and narrative analysis of the structure of each story (Braun and Clarke 2006; Riessman 2008).

There are methodological limitations to this study. Given the substantial time investment required to participate in the workshop, the students were self-selecting and primarily motivated by an interest in climate and storytelling. As there were a small number of participants, and independent schools were overrepresented, the participants are not representative of young people in the UK and Ireland. Demographic data wasn't systematically captured about participants, limiting any comparisons based on gender, ethnicity or other factors. As the workshops took place during COVID-19 regulations, they were delivered through a hybrid in-person and online format, which meant the digital storytelling workshops varied in format for different groups of participants. Online sessions also limited opportunities for strengthening the relationship between researcher and research subjects, or gathering data through participant observation.

The digital stories are available online at <http://tinyurl.com/lettersfrom2050>. An animation based on the digital stories is available at <https://vimeo.com/tamarackmedia/2050>.

Change

It is up to you how much light there will be in the dark, and what remains as an anchor of positivity, hope and joy.

Results

The digital stories created by the research participants ranged in length from one minute and seven seconds to four minutes and 22 s. While most of the videos followed the format of a letter from the year 2050, a handful departed from the initial prompt: two students wrote poems as the narration, one student wrote a letter from the present to the future, one student produced a video without any narration, and one student wrote a personal reflection on a local rewilding project that involved the failed reintroduction of beavers.

The digital stories utilised a range of visual materials, including stock footage and photographs, original footage and photographs created by the participants, illustrations and text. The majority of videos primarily used stock footage that was included with the WeVideo editing software. While much use of the stock footage was *show-and-tell*, directly illustrating the text of the script, the



Figure 1. Still frame of the digital story DS08.

filmmakers also used visual metaphors, with repeated images of sunrise, sunset, clouds, and flying birds. Ten videos were completely composed of original footage, including a story with a single long shot of Brighton Pier with natural sound (Figure 1), which the filmmaker explained in her filmmaker statement.

When given the brief I instantly thought of the sea and the beach as this is the place where I feel most connected to nature and where I often reflect. At the start I found the process rather overwhelming and daunting, thinking about the future in this way, and I took more of a pessimistic approach. However, as the project went on, I decided to change my stance and focus on the way we have adapted and that it isn't as bad as I may have imagined (DS08).

A small number of digital stories, all created by female storytellers, included personal images, especially at the beginning and end of their videos. These were accompanied with more personalised, emotional messages from the future self to the current self. 'Make sure to look after yourself, love yourself, and keep making changes, no matter how small, so you'll be able to appreciate the world as much as I am now. I love you baby girl' (DS20).

The pacing of the editing varied greatly, with some videos composed of a small number of still images and video clips held on screen for a number of seconds, and other stories including fast-paced sequences where visuals only remained onscreen for a fraction of a second. Videos also included layering effects, in which more than one image appeared onscreen at the same time, for example to juxtapose imagery of the causes and impacts of climate change. Filmmakers also layered text over visuals to reinforce key ideas from their narration.

Twenty of the videos had no music, with the other twenty-seven primarily using stock music available through WeVideo. The music tended to be fairly dramatic, although some videos had a more contemplative soundtrack. A small number of videos included a music transition to reflect a change in content and tone.

After a close reading of the digital story transcripts and repeated viewings of the visual material of each story, twelve themes were identified (Table 1). Looking at an entire digital story as a cohesive narrative, rather than breaking the transcript and visuals into smaller units for coding and analysis, revealed patterns in terms of story structure and style. Based on this narrative analysis, nine different types of narratives were identified in the digital stories (Table 2).

Through their writing and use of visuals, the storytellers presented positive, negative and nuanced visions of the future. There were narratives of destruction and decline, even collapse; dystopias illustrated with scenes of pollution, extreme weather, flooding, and fires; stories of loss and solastalgia. The students also created narratives of progress towards green utopias with visuals of green technology – wind turbines, solar panels – and discussions of new forms of transport, agriculture, and architecture. In some cases, the positive narratives reflect a new consciousness of harmony with nature, and an intersectional approach to social and environmental problems.

The participants also presented more complicated visions of the future using a variety of narrative strategies. Counterfactuals included both positive and negative futures, juxtaposing what *could have* happened between now and 2050 with what *did* happen, or contrasting present day hopes and fears with the lived experience of a future self. Stories of discontinuities – future events that mark a break between current and future trends – explain the transition between a worsening short-term and a longer-term 'period of repair, of restoration, of rebuilding' (DS44). Stories also present a form of 'staying with the trouble' (Haraway 2016), in which young people are clear eyed about loss and injustice, while articulating narratives of adaptation, resilience, and appreciation for the natural world.

Most of the digital stories included visual and script references to climate protests, a tangible form of climate action for students, especially with respect to the Fridays for Future school climate strikes. Individual climate actions were presented as a path to collective action and systems change, although young people didn't express much faith in politicians and governments taking necessary

Table 1. Themes identified during reflexive thematic analysis.

Theme	Description	Example(s)
Biophilic design	Many stories described a future in which people lived in harmony with nature, urban areas had been rewilded, and architecture reflected biophilic design (Kellert and Finnegan 2011). Imagery of the Supertree vertical gardens in Singapore appeared in multiple videos (Gardens by the Bay n.d.).	'Humans and nature have begun to live in harmony, with vines and trees growing magnificently, and urban life moving with them, instead of just destroying them, like in the past' (DS42).
Education	When describing climate solutions, many storytellers referenced the importance of education. In addition to environmental and sustainability education, access to education for girls was seen as an important response to climate change.	'Schools also now teach future generations how to look after the Earth and how to be mindful of everything they do and how it will affect the world' (DS46). 'Children are being educated about their upcoming responsibilities' (DS43).
Gratitude	A number of videos used natural imagery combined with narration expressing their gratitude for the natural world, or specific natural places and activities.	'Please always remember to look up around you, embrace the fresh air, the smell of flowers, the snow in the winter, appreciate the clean beaches, the warm summers, and the trees around you. Because this is what you are fighting for' (DS25).
Green technology	Most of the digital stories also included some representation of green technology, primarily reflected through solar photovoltaic panels and wind turbines. Some videos also mentioned changes in transportation, including self-driving electric cars, and skyline shuttle pods controlled by apps.	'Now we have the ability to rely almost exclusively on renewable, clean energy, having invested enough in solar, wind, and other crucial sources of renewable energy' (DS06).
Individual/systems change	Many of the videos describe changes in patterns of behaviour, such as more plant-based diets, an end to fast fashion, and plastic-free shops. These individual actions were described as pathways to collective action, and also referenced as part of messages of encouragement.	'It all starts from the baby steps, the union of society, of everyone making their contribution' (DS41). 'So all the small actions that you're taking now, although they may seem insignificant at the moment, they'll play a major role in saving our planet' (DS46).
(In)equality	Many videos referenced inequality and social justice, reflecting an intersectional approach to social and environmental issues. Some stories painted a picture of increasing inequality, while other stories reflected decreases in inequality.	'In 2050 you will see the rich retreating into air-conditioned sanctums behind ever-higher walls and the poor left exposed to the ever harsher elements' (DS06). 'The unnecessary suffering has been avoided by no longer prioritising the rich and wealthy but focusing on making sure no one has too little, no one has too much' (DS42).
Government (in)action	Governments and the political process were mainly seen as obstacles to addressing the climate crisis. Some videos referenced the success of the Green Party and local government action, while others emphasise international cooperation.	'Politicians did nothing to stop climate change' (DS07). 'The fake promises governments made to act on climate change are now more than visible and the consequences can be seen globally' (DS33). 'The people you trusted to fix it failed' (DS34).
Loss and damage	Borrowing the language of the UNFCCC, most of the letters include references to and visual representations of loss and damage – hurricanes, flooding, forest fires, drought – and the resulting human suffering.	'I'm talking about droughts and floods that seem to be as often in the news, as COVID-19 is in your life right now' (DS37). 'The world is ablaze ... The world has been lit with damage' (DS30).
Pollution	A number of specific stock footage clips of smokestacks and powerplants were repeated, as well as smog-filled cityscapes, with references to poor air quality. The storytellers also frequently mentioned the face masks worn during COVID-19 as a regular part of life in the future due to poor air quality. There also were many references, in both visuals and scripts, to polluted waterways and plastic in the ocean.	'The unbearable air, reeking of industrial dirt and acting as glue by making my lungs sticky and ineffective' (DS37).
Protest	Another stock footage clip that appeared in most of the videos was of climate change protesters holding handmade signs. One story included a photo of the filmmaker at a school climate strike.	'After an incredible amount of protests and education, the world took it seriously' (DS45).
Refugees	A number of digital stories described climate migration as a means of exploring both global climate injustices and potential xenophobic reactions to refugees.	'At the same time, sitting in front of our borders and waiting to be let in are millions of refugees. Refugees, because of the unbearable and destructive climate in their home countries. Refugees, because the air is even hotter, drier and

(Continued)

Table 1. Continued.

Theme	Description	Example(s)
Solastalgia	Many videos referenced destruction of the natural world and the sense of loss due to environmental change, which echoes the concept of solastalgia (Albrecht et al. 2007). Solastalgia implies a connection to place, and the feeling of loss when that place changes.	harder to inhale in the countries they escaped. Refugees, because we, society as a whole, didn't seem to care enough' (DS25). 'I am still based in England, but it is not the same place that I once loved' (DS01). 'I don't mind where I live, but the world feels cold; nowhere feels like home' (DS12).

action unless under great pressure from civil society. Storytellers also presented their participation in climate action now and in the future as a means of ensuring they can live without regret, even as the climate crisis continues to unfold.

The filmmaker statements provided additional insights into the participants' motivations and creative process. One storyteller initially drafted a letter that went into great detail about a negative future, but, when it came time to create a video, he abandoned the original letter and went to film in a local natural area (Figure 2). The resulting digital story reflected the theme of solastalgia and narrative of memory, and storytelling intent was captured in the filmmaker statement:

During my time filming, I thought showing the potential effects of global warming in an extremely personal and significant place would be really impactful. I hoped that demonstrating what could happen to my favourite place might help people watching the video understand what may happen to theirs and thus enact genuine change. I also wanted to capture the beauty of the environment and what is at risk if we don't work to change our impact on the environment (DS02).

The focus group conversations at the end of each workshop, after the participants had shared their final videos, were also an opportunity to further explore filmmaker intentions and the impact of the digital storytelling process. Students expressed satisfaction with creating their digital stories:

**Figure 2.** Still frame of the digital story DS02.

Table 2. Narratives identified during narrative analysis.

Narrative	Description	Example(s)
Collapse	While many negative visions of the future are reflected in the videos, a small number described a population crash and complete collapse of civilisation.	'Few humans have survived Mother Earth's wrath, with the last remaining few wandering the polluted surface, hoping for any salvageable food or water' (DS11).
Contingency	Nearly all videos emphasised that the future was unwritten, with references to hope and calls to action often appearing at the very end of the video. This message of contingency reflects both the potential agency of the viewer/storytellers as well as their uncertainty about the future. The science fiction and time travel implications were also playfully addressed.	'Although our current situation seems helpless, there is hope . . . Keep fighting' (DS35). 'Due to laws created in 2048 pertaining to the sharing of personal information in time-travelling letters, blah, blah, blah, blah, blah, I'm not permitted to tell you how your careers, relationships and family situations pan out. Space-time continuum stuff' (DS31).
Counterfactual	Many of the videos explored multiple possible futures in a single narrative. For example, one video explicitly introduced both positive and negative visions, while another video included a hypothetical description of what <i>could have</i> happened rather than what <i>did</i> happen. Similarly, current day hopes and fears were contrasted with the imagined future.	'I can't help but wonder what could have been. Climate tipping points might have already been reached, causing catastrophic climate change and loss of biodiversity' (DS21). 'The world today is different from the one you once feared, the world you hated to imagine, and the world that filled you with hopelessness and frustration' (DS20).
(Dis)continuity	A number of the digital stories described a worsening near-term future followed by a more sustainable long-term future. A few of these transitions were described in terms of a world-changing event, a discontinuity between past and future, for example the 2034 London air pollution crisis (DS19).	'But then in 2035, it all changed. The biggest drought the world had ever seen swept the globe, populations halved, water supplies dwindled, but from the dust arose revolution' (DS05).
Enlightenment	A small number of stories describe a new consciousness of harmony between humans and the more-than-human world, reflecting a narrative arc towards enlightenment that is distinct from the utopian visions characterised by green politics and technology.	'There is a new culture of trust and empathetic understanding for one another. I look around and everyone seems healthier, happier, without these feelings of helplessness and chronic frustration towards climate change' (DS20).
Living-with	Echoing both Verlie (2022) and Haraway (2016), many of the stories reflect the ambiguity of a future where climate change resulted in substantial loss and suffering, but people also adapted individually and collectively.	'Things have changed. But we remain closer to a tipping point than feels comfortable. The precarious balance of two steps forward, one step back. It wasn't like in the films. There was never a point when you breathed a sigh of relief and decided that good had defeated evil. Too many natural wonders were lost due to our actions. Too many species whose fates have been restricted to the history books. Too many lives lost because of the greed and unbridled power of a few. It's hard to feel that we've won, as politicians like to claim. A ticking time bomb remains and there's lots of work to do' (DS44).
Memory	A number of the digital stories are memories from the future of specific places or experiences, with the storyteller including original footage and photographs of these local places of personal importance.	'Do me a favour and take a moment to think about all those long walks you go on with your family' (DS26). 'Do you remember this? It's your favourite hike . . . You remember, right? That taste of fresh air you valued so much, loved so much. Well, it's gone now' (DS02).
Revenge	A few of the stories present a narrative in which the natural world exacts revenge upon humanity. These narratives tend to present a misanthropic perspective.	'The planet I live on has begun vindicating itself of the virus that is humanity' (DS11). 'Mother Nature came for us, showing us the same mercy we have shown to her, as resolute in her cause as we were to protect money over life' (DS34). 'We exist and Earth is still our home but she is broken. We made her deadly and ruthless and relentless. She was angry. She knew no boundaries and showed no mercy' (DS24).
Utopia/ Dystopia	Most of the digital stories presented either a fully positive or negative picture of the future – narratives of a world of improvement or decline. The dystopias were characterised by strong emotional language.	'I am so ashamed of what we have let our world come to' (DS01). 'Climate change has ruined my life and it will ruin yours soon too' (DS30). 'I do feel like this green, state-of-the-art utopia is all a bit in your

(Continued)

Table 2. Continued.

Narrative	Description	Example(s)
	The utopias focused on positive changes in energy, transportation, food, and architecture. One filmmaker presented a positive vision, but critiqued it.	face though Countries competing over who can create the most flamboyant green architecture, who can build a new <i>it</i> city, because sustainability has become the new <i>it</i> word' (DS18).

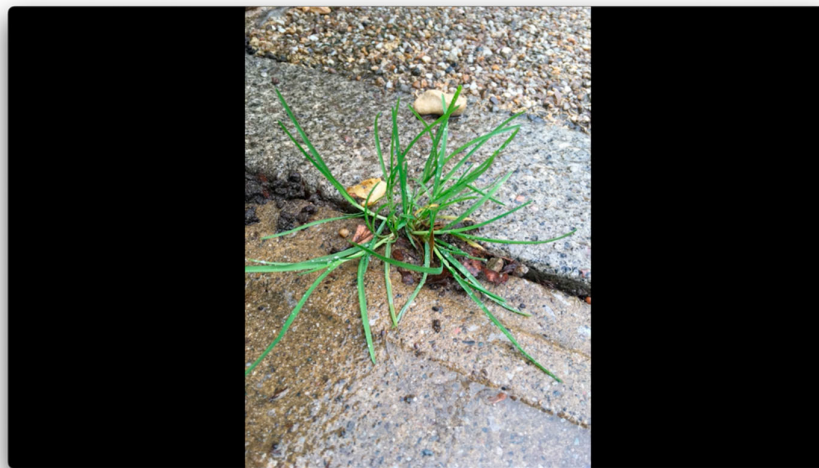
Student 1: I feel really proud. I was really excited to finally see the finished product Even though I sound really weird, I'm quite happy with the way that it's coming across now.

Student 2: When you write something . . . you kind of visualise it in your head. And so I guess that kind of gave us the opportunity to do that. And seeing it come together, even though it was obviously not exactly the vision that I saw, it was close, and that was quite satisfying as well (W2).

In these focus groups, the storytellers also reflected on the intended impact of their videos on potential audiences. For some, the stories were an opportunity to see through their initial ideas, 'I kind of did it for myself. I didn't think about the viewer at all. I just thought about making the video' (W3). Students also spoke about storytelling as a means of cultivating empathy, 'I think I want the audience to feel empathy . . . and maybe do what they can to maybe prevent any further destruction' (W4).

A couple of filmmakers, both male, spoke about how they changed from a more positive vision when they initially wrote the letter from the future to a negative depiction in their final video because they thought that would be more entertaining. Students also identified the cultural influences on their depictions of the future, 'It reminded me of apocalyptic climate films like *Snowpiercer*, where the whole world is frozen, and other fiction films, which actually could be a reality a couple years down the line' (W2). When explaining the choice of a narrative of collapse and visual metaphors of weeds growing through cracks in the pavement (Figure 3), one participant commented, 'I feel like I've sort of mentally accepted the death of civilisation. It's gonna happen, but we can keep looking out for each other.' (W1).

Students across the focus groups also spoke about the invitation to explore the future: 'We're attending loads of careers talks and things like that. A lot of "the future" is based on what you're

**Figure 3.** Still frame of the digital story DS39.

going to do and your goals. But you never really kind of stop and think how different the world is going to be around you when you reach that point in your life' (W4). The storytellers also reflected on the strangeness of telling a story about the future in the present. For some, this involved the memories of the future captured through present day original footage. For others, this was based on using current stock footage to illustrate future climate catastrophes. 'My piece has forest fires that happen in 2050, but it is literally just taken from now. And so it's ... kind of weird saying, oh look, this is what happens in 2050. They are actually happening now' (W7).

An exercise during the workshop involved participants choosing three words that related to how they felt about the future, which were related to the taxonomy of climate emotions described by Pihkala (2022). This happened during the initial session after exploring climate science and future scenarios, and then again during the focus group conversation at the end of the workshops. In one workshop, the main sentiment expressed changed from overwhelmed in the beginning to a combination of hopeful and ambitious at the end, which one of the participants noted in the focus group: 'I'm happy that these [hopeful and ambitious] are the two words that most people used, because it implies that there is hope, we are looking for solutions, and we are looking forward to making progress' (W2).

In one of the focus groups, students discussed how their emotional responses to a future shaped by our collective response to the climate crisis changed over the course of the digital storytelling workshop.

Student A: I was worried and frustrated before. I still am, but I think I'm more ambitious now and kind of optimistic that we can make a difference.

Student B: I agree, it's definitely made me feel more optimistic. And something I said in my letter was about me doing actions now which will mean I don't have to live with regret in the future. And that ... makes my actions now feel meaningful and worthy.

Student C: I feel like I'm at peace with what I am doing to be on the right side of history ... I have kind of accepted, especially with thinking about it a lot more over the last three weeks, what my role is within everything. And, obviously, I'll never truly accept it, but I'm definitely a lot more accepting of the facts and reality now than I was maybe a year ago when I was just filled with anger and really frustrated about it. Whereas now I think, 'why focus on those emotions when you can do other things and use your energy better'.

Student D: I'd still say that I'm worried about it. Of course, I guess most people probably are. But I also feel like if I tried to do everything that I, as one person, can do, it might spark something in people around me if they see me doing something (W3).

While the digital stories presented positive, negative and mixed socio-climatic imaginaries, including the range of themes and narratives outlined above, the reflections of the storytellers more consistently indicated a shift from a general sense of dread about the future, to a combination of worry, acceptance and curiosity. As the discussion above illustrates, engaging with the future – creatively, collectively – played a role in this shift in perspective.

Discussion

The primary goal of this research was to explore how young people imagine futures shaped by climate change and our collective response to the climate crisis using the research method of digital storytelling.

Despite time constraints, limited tools, and no budgets, the young people proved sophisticated storytellers, effectively combining voice, music, photographs and video, and utilising editing techniques such as pacing, transitions, and layering. The digital stories reflect a number of influences, from classroom learning and personal environmental activism, to cultural references and speculative fiction, for example referencing space travel, time travel, future memories, and apocalypse. Visual metaphors – sunrise and sunset, clouds moving across the sky, birds in flight – were left

to viewers to interpret, and simultaneously communicated contemplation about the future, changes in atmospheric chemistry, and hope.

The speculative digital storytelling process and resulting stories communicate a wide variety of imagined climate futures, as illustrated by the themes and narratives identified above. This study builds on related research exploring future scenarios with young people, which found that students held mixed emotions about the future, reporting high levels of both hope and anxiety (Finnegan 2022). The digital stories add a richness to this picture, especially through the words and voices of the research participants, while similarly resisting any shared, homogenous vision of the future. Taken as a whole, the *letters from the future* capture the uncertainties, worries and possibilities young people face, especially those actively engaged in climate activism.

The negative visions expressed in many of the digital stories paint a bleak picture of the world in 2050 – stories of dystopia and collapse characterised by pollution, loss and damage, and refugees. While in some ways these visions are specific to the climate crisis, fears of the future being worse than the present are not new. A study in the 1980s in which students wrote about a normal day in their life in the year 2000 reported expectations of ‘violence, unemployment, high technology, boredom, inflation, poverty, pollution, material prosperity’ (Brown 1984). A similar Australian study in the 1990s that involved young people envisioning the year 2010 found, ‘most young people see the future mainly in terms of a continuation or worsening of today’s global and national problems and difficulties’ (Eckersley 1999, 77). Eckersley acknowledged these visions had even deeper roots: ‘Apocalyptic myths about “the end of the world”, which have always been part of human mythology, including most major religions (this relates especially to fears about global catastrophe, such as a nuclear holocaust)’ (1999, 84). Alternatively, Hicks (1996) connected fears about the future of young people in the UK to contemporary socio-political concerns. The digital stories in this study reflect both archetypes in storytelling and climate change as a contemporary issue that is shaping perceptions of the future, although that is perhaps unsurprising given the research design and participants.

The positive solutions – presented visually and in the video narration – emphasised two themes: green technology, like renewable energy, and individual change, for example more sustainable consumer choices. Researchers have critiqued climate policies that overly rely on techno-solutionism, and the UK Climate Change Committee’s Net Zero report assessed that 62% of emissions reductions would need to come from societal/behavioural changes and measures that combine societal/behavioural changes and low carbon technologies (Committee on Climate Change 2019; Nelson and Allwood 2021). Social scientists have also critiqued environmental policies and discourses that focus on behaviour change rather than systemic change related to power, culture, and social practices (Shove 2010). Climate educators interested in the practice of speculative digital storytelling may need to actively introduce concepts related to sociotechnical transitions and systems (change) thinking into the digital storytelling workshops to address these critiques.

The second concern of this research was the impact on young people of creatively engaging with the future through speculative digital storytelling. As an arts-based form of participatory action research, digital storytelling methods are acknowledged to potentially have an impact on the research participants. The digital storytelling workshops were also a form of environmental and sustainability education that creatively engaged with climate change, with potential outcomes in terms of knowledge, attitudes and behaviour. This impact was explored in the focus group conversations at the end of each workshop, where students expressed satisfaction and pride in their work. Specific skills and competencies related to digital communication were also demonstrated by the students through their multimedia productions.

Through an exercise in which the participants identified the emotions they feel with respect to the future, the digital storytelling process appears to have supported a shift from more negative to more positive emotions. While the participants were still worried about the future, they also expressed an increase in acceptance, curiosity, and hope. As Hogan and Pink (2012) noted, inter-iority is not static and crystallised when extracted as data, and creative research methods may

provide deeper access and also influence inner states. Changes in young peoples' emotional responses to the future also relate to Ojala's model of climate hope that includes positive reappraisal: 'Positive reappraisal is about perceiving the threat but being able to reverse one's perspective and also activate positive emotions that can help one to face the difficult situation and deal with worry constructively' (2012, 636). Ojala's model of hope also includes trust in both self and others, and the shared experience of the digital storytelling workshop may contribute to the collective nature of climate hope. The digital storytelling process also directly responds to calls by Rousell and Cutter-Mackenzie-Knowles for more 'interdisciplinary, affect-driven and experiential approaches to climate change education' (2020, 6). The shift from negative to positive emotions is a valuable outcome in response to widespread climate anxiety among young people (Hickman et al. 2021). In addition, recent research has found a strong relationship between the emotional/cognitive concept of climate hope and action competence, which is the ability constructively engage with future environmental challenges (Finnegan 2022).

In their handbook on digital storytelling, Lambert and Hessler reference a number of applications of story work, including environmental activism and scenario planning (2020). This research is the first reported application of speculative digital storytelling to environmental issues and could be used as a model for future digital storytelling research and practice. The personal, reflective, creative approach of speculative digital storytelling, especially using the prompt of a letter from the future, provided an opportunity to productively engage with the climate crisis, develop futures literacies, and explore the concept of being a good ancestor. Future research could use speculative digital storytelling on other environmental or social issues, as well as work with different age groups. In addition, the students primarily used the stock footage and music provided in WeVideo, and productions may have been very different if original filming and photography was required. While this model of digital storytelling workshops works best with small groups and involves a substantial time commitment, and thus is difficult to scale, there are a wide range of creative activities that can help students develop futures literacies (Miller 2018).

Closure

Use your voice to be as loud as you can – our voices are louder together. I'll leave you there, but keep your eyes open. Take care.

Young people are not experts in future scenarios, policies or technologies. Nor are they fortune tellers. However, younger generations will experience more of the future than older generations, with opportunities to individually and collectively shape it over the course of their lifetimes. The socio-climatic imaginaries young people articulate through speculative digital storytelling reflect their hopes and fears, their sense of both the possible and the inevitable. The process of creatively engaging with the future not only extends their time horizons and futures literacies, but it also provides opportunities for facing climate anxiety, positive reappraisal, and constructively engaging with the climate crisis.

For educators, and others looking to help young people develop resilience and agency, the digital storytelling process can be used as a form of creative, participatory climate education, exploring the causes and impacts of climate change across multiple disciplines, while centring the emotional response of young people to the climate crisis. The results of the digital storytelling process are also powerful tools for further education and engagement, so that work with a small group of students can extend throughout a larger school community.

Students in the UK and Ireland, especially those from a privileged background, are largely sheltered from the already unfolding impacts of climate change on frontline communities. However, exploring their worries about the future in a supportive environment can develop empathy for and solidarity with others, and appreciation for the more-than-human world. Creatively engaging with preferable futures allows young people to anchor their hopes on existing green technology,

different ways of living, and governments responding with the same urgency as they did with the coronavirus pandemic.

A consistent message in digital stories – the letters from young people’s future self to their present self – was contingency. Young people are future-shapers, or as one story put it, ‘think about your future and remember: you’re the one who has to live in the world you create’ (DS11). The digital storytellers also spoke of living without regret. As another storyteller concluded: ‘The one thing I really wish I’ll be able to say in 2050 is that I still have hope, that I can still see the silver lining, and, even if things are worse than they’ve ever been, I hope I will feel like I’ve done enough’ (DS47).

Note

1. The structure of this article is based on a storytelling model shared by the StoryCenter in their digital storytelling trainings: connection, context, change, closure. Below each section header is a quote from the animated video created from the digital stories produced through this research (<https://vimeo.com/tamarackmedia/2050>). The quotation in the title of this article comes from DS45.

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6

Discussion

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This chapter weaves together the preceding three academic papers, offers reflections on the impact and contributions of this research, and shares some thoughts on future directions for climate education research and the role that I might continue to play in this field.

6.1 Weaving

One challenge of the article-based thesis – especially for research that deliberately engages with multiple academic disciplines and aspires to transdisciplinary insights

– is to see this work as a coherent whole. Chapter three can be thought of as the empirical foundation of the thesis, positioning this work in secondary schools in England, recognising that these schools are material and social institutions with the semantic purpose of teaching and learning. Theories of social practice, in particular practice architectures, were used as an entry point to understand school sustainability in terms of patterns of activity enabled by semantic, material and relational arrangements. This chapter also introduced the tradition of whole-school approaches to sustainability, and Biesta’s model to articulate the purpose and function of education. Chapter four more specifically engaged with the field of environmental education research, exploring the relationship between teacher practices and student ratings of anticipatory concepts such as climate hope, climate distress and action competence. The structured nature of the questionnaire, and its use of previously developed and validated scales, allowed for comparisons based on subgroups of students, for example students attending state versus independent schools, or students that identify as female versus male. Chapter five continued this investigation of how young people perceive a future shaped by climate change and our collective response to the climate crisis. Building on recent interest in children’s geographies in the cognitive, social-emotional, and behavioural aspects of climate education, this chapter recounts the creative, participatory method of speculative digital storytelling, and narrative and reflexive thematic analysis of the resulting multimedia data. The sections that follow weave these papers together using three integrative concepts: education, futures and storytelling.

6.1.1 Education

The first thread to weave through the three articles is the purpose and function of education, especially in terms of Reid’s application of Biesta’s model of the purpose and functions of education to climate education, as shared in chapter two. While not advocating for a particular purpose, Biesta indicated that education could be understood through three distinct functions: qualification, socialisation, and subjectification. To briefly define, these functions can be understood as the

knowledge and skills related to studying a specific subject, the hidden curriculum of social practices transmitted through educational institutions, and the development of self-knowledge and agency in learners. The bundle of social practices related to teaching and learning in schools can also be understood through the semantic, material and relational dimensions of practice architectures, as set out by Kemmis and also discussed in chapter two. By bringing together the work of Biesta and Kemmis, this thesis underscores that the achievement of standardised qualifications in specific subjects that allow students to pursue further education and embark on careers is only one aspect of the formal, informal and non-formal learning and personal development – and the arrangements that enable this learning and development – that takes place through schooling.

Educational form follows educational function, and therefore teacher practices can and should respond to the articulated and implicit purposes of education. For climate education, there are growing concerns about the affective and social-emotional implications of learning about climate science, impacts, mitigation and adaptation. This research confirms the importance of hope-based pedagogies – teacher practices that support the expression of negative feelings about the future, maintain a positive and solution-oriented outlook, and encourage a process of positive reappraisal. This type of climate education was also modelled through this research via speculative digital storytelling workshops, a research method and educational intervention that created opportunities for young people to collectively and creatively engage with positive and negative futures.

This integration of the purpose and function of education and the practice architectures of schools extends beyond the curriculum and the classroom. Kemmis understands learning as the reproduction and transformation of practices and the creation of new practices. Contradictions between school lessons and the design, operations and day to day life in a school threaten to undermine the adoption of more sustainable practices, which has led to the development of whole-school approaches to sustainability. From this holistic perspective on environmental, sustainability and

climate education, school buildings are teachers, school contracts and policies are educational texts, and the menu for lunch each day provides instructional scaffolding.

6.1.2 Futures

The second thread continues on the theme of futures. The national curriculum of England provides an initial foothold for connecting education with ideas about the future:

Every state-funded school must offer a curriculum which is balanced and broadly based and which:

- promotes the spiritual, moral, cultural, mental and physical development of pupils at the school and of society
- prepares pupils at the school for the opportunities, responsibilities and experiences of later life (Department for Education, 2014)

This explicit goal of preparing young people for later life is an organising concept of formal education. While a deeper dive into the philosophy, policy and politics underlying the national curriculum is beyond the scope of this research, embedded in the curriculum are particular ideas about what the future holds, and the knowledge, understanding and skills that are necessary to navigate this future. These socio-technical imaginaries inform the development of and are reflected in the curriculum. At the same time, the development of the curriculum can be an exercise in looking backwards rather than forwards, shaped less by anticipation than by history, while reinforcing the power structures and ideologies of the present (Lambert and Walshe 2018).

As noted in chapter two, this thesis draws on the work of Ojala and Facer in terms of anticipatory forms of education, and cognitive and emotional concepts such as constructive hope. As explored in chapters four and five, young people are acutely aware of possible futures shaped by climate change. They think negative scenarios with respect to climate change are more likely than positive scenarios, and tell powerful stories about future fires and floods, and the devastating human and non-human toll of climate change. Young people also articulated complicated futures, narratives of discontinuities, counterfactuals and contingency, in which hope and anxiety coexist and each have a relationship with climate action.

The disconnect between the future young people anticipate and the future that education is preparing them for is an important theme of this research, a gap that becomes clearer when the three papers are read together. This also relates to what Stirling identified as anticipative education versus retrospective education, and the anticipatory thinking competency of education for sustainable development (Stirling 2013, QAA and Advance HE 2021). In chapter three, individual schools reflected the larger educational system – with the material, discursive and relational practice architectures resisting change towards more sustainable practices. At the same time, chapters four and five indicate that young people believe that the ‘opportunities, responsibilities, and experiences of later life’ are being shaped by climate change, a belief that is supported by the scientific community, for example the Intergovernmental Panel on Climate Change. Taken together, the papers in this thesis contribute to a case for reform to make the education system more responsive to the future, and pedagogies that support the development of anticipatory competencies in learners.

6.1.3 Storytelling

A third thread woven through the three papers is the individual and social role of storytelling. The theory of practice architectures includes the concept of semantic intersubjective space, where language and discourse enable or constrain social practices. This aspect of practices is the story of sustainability, as told in the classroom, communicated through the values of a school and the agenda set by governors and senior leadership, and embedded in the signage and social media of student campaigns and protest. Exploring the politics and social function of storytelling, Michael Jackson offers two theses:

The first derives from Hannah Arendt’s argument that storytelling is a strategy for transforming private into public meanings (though, as I shall show, this process cuts both ways); the second is existential, seeing storytelling as a vital human strategy for sustaining a sense of agency in the face of disempowering circumstances (2013, 34).

Jackson thus provides a bridge between stories as an intersubjective space in the relationship between practices and practice architectures, and the role stories play to generate a sense of the possible and assert some agency over shaping the future. The questionnaire that Sixth Form students and teachers completed through this research included a series of positive and negative future scenarios, stories about the future which were rated based on likelihood and desirability. The digital storytelling process invited young people to tell their own stories through the vehicle of a letter written by their future self in 2050 to their current self in 2021¹. This creative process, imagining futures desired and feared, gave them voice, authorship and editorial control, through a shared experience with other young people, and a participatory framework for sharing their stories beyond the research project. Speculative digital storytelling thus emerged as an action research method and action learning process.

Storytelling – the crafting of coherent narratives from the complex multisensory experiences of life – shapes individual identity and collective meaning, gives us a sense of agency over the events unfolding in our lives, and defines possible futures. Storytelling helps us articulate the goal-setting, way-power and will-power aspects of constructive hope. Storytelling is a tool for participating in the ‘sayings’ of the semantic dimension of practice architectures, developing the interpersonal ‘relatings’ of the social dimension of practice architectures, and making sense of the ‘doings’ in the material dimension of practice architectures. Going one step further than Jackson, I believe the evidence presented here demonstrates that storytelling has the potential to not only sustain a *sense of* agency, but to also support actual agency and our ability to shape the future.

6.2 Reconciling

As an interdisciplinary work seeking transdisciplinary insights, this thesis draws on a wide range of theory in the disciplines of environmental education, children’s geographies and energy studies. The key concepts and references are covered in

¹The animation combining the voices of multiple digital stories produced through this research is available at <https://vimeo.com/tamarackmedia/2050>.

chapter two, as well as the literature review sections of the three articles. However, these different theoretical perspectives should be briefly reconciled to clarify how futures and change are conceptualised in this thesis. Specifically, a few questions are worth addressing: how do I understand change in the context of education, what is the relationship between ideas of the future and action in the present, and how do practices and agency relate to each other? These questions can be answered through a practical example – if one were to design a sustainability curriculum for all students at the University of Oxford, what content would it include, how would it be taught, and what would be the desired outcomes?

Change – individually and collectively – is required to alter our current unsustainable trajectory of ecological destruction and climate crisis. Environmental education has long been concerned with creating, in the words of the Tbilisi Declaration, ‘new patterns of behaviour of individuals, groups and society as a whole towards the environment’ (UNESCO 1978, 26). This thesis builds on critiques of narrowly defined (environmental) education as remediating an information-deficit or indoctrinating learners into specific (pro-environmental) behaviours, arguments with echoes of Dewey and Freire which have been articulated through the concept of action competence. I also draw heavily on Biesta’s formulation of the function and purpose of education, especially the concept of subjectification. How, then, does education foster change, especially the necessity to change how we live in relationship to each other and the natural world?

Biesta (2020) describes subjectification as our freedom to act – or refrain from acting – and this can also be seen as the freedom to participate in individual and collective change. Biesta draws on Arendt (like Jackson earlier in this chapter) to emphasise that this process of acting cannot happen as isolated individuals, but only in relationship to others, who may take up our *beginnings* of action. Biesta has also reflected on the relationship between teaching and learning, and the realisation of subjectification when we turn from the self to the world:

[T]he critique of teaching-as-control immediately ends up with the idea of learning-as-freedom. . . . I have also suggested that a different alternative *ought to be* possible. These ideas, then, begin to outline a non-egological

approach to teaching, an approach that is not aimed at strengthening the ego, but at interrupting the *ego-object*, at turning it towards the world, so that it can become a *self-subject* (2019, 62).

Given the inclusion of futures as one of the threads that weaves together this thesis, we also need to turn to the relationship between action in the present and conceptualisations of the future. Facer (2016) cautions against three modes of engaging with the future in education: rational (neoliberal) optimisation, colonisation by (progressive) desires, and the protection against (frightening) unknowns. Following Facer and Sriprakash (2021), to talk about the future in the context of education is to be critical of authorities on and normative ideas about *the* future, to grapple with multiple possible futures and futures literacies, and to bring curiosity and collective inquiry into a process of anticipation and emergence. In the digital storytelling project in which young people explored climate futures described in chapter five, one of the key themes from the narrative analysis was the concept of contingency – the uncertainty of our prophecies and predictions, the possibility of multiple futures. Facer, reflecting on forms of storytelling and play with the future, makes the link back to action in the present:

Such an approach, rather than treating the present as the impoverished handmaiden to ‘a brighter future’ or as the ante-room to the apocalypse, instead sees the present as an abundant resource, a site of rich and powerful possibilities. It asks how we might make visible the creative resources that we have around us today to open up new forms of action (2013, 141).

This interplay between education and action, present and future, brings us back to theories of social practice, another theoretical anchor of this thesis. By shifting from individual behaviours and choices to broader patterns of activities and the arrangements that enable them, theories of social practice position agency as situated and distributed. In this thesis, I’ve drawn heavily on the theory of practice architectures articulated by Kemmis as capturing the sayings, doings and relatings of practices, as well as his concept of learning as the (re)production and transformation of practices. I’ve attempted to reconcile theories of social practice with Biesta’s

framework for the function and purpose of education: qualification representing the skills required to carry or continue certain practices, socialisation reflecting the transmission and reproduction of practices, and subjectification as the ability to challenge, transform and create new bundles of practices and arrangements.

Turning to the practical example, I am now involved in developing a learning experience which will be offered to all Oxford undergraduates and will explore climate change in the context of broadening the curriculum and supporting the development of interdisciplinary thinking and skills. This offering could:

- Turn learners to the world – locally and globally engaging with the climate and nature crises – as a form of ecological, non-ecological teaching.
- Incorporate small group projects to explore relational, collective aspects of agency and action.
- Embed criticality, curiosity and creativity in questions of possible futures.
- Encourage systems thinking – especially the intersecting geophysical, ecological, and social systems at the root of the climate crisis – and a social practice-informed view on systems change.

This section is perhaps a little too tidy in the reconciliation of different theories and schools of thought into a cohesive thesis. There are rough edges where these ideas bump into each other, irreconcilable ontologies and epistemologies embedded in disciplines of thought and disciplinary identities. I find myself navigating these turbulent waters as best I can, down the river of practices, along the banks of practice architectures (Kemmis 2022), into an estuary of the thick present where past meets future (Facer 2016).

6.3 Contributions

The past 3.5 years have been challenging and rewarding, with my time as a doctoral student primarily focused on my academic training, and personal and professional development. At the same time, doctoral research must to some degree positively

engage with and contribute to a field of study. In addition, having spent June 2003 to September 2019 outside of academia, I have a personal interest in broader definitions of impact, especially in terms of sharing my research with environmental educators and young people engaged with climate activism. In Appendix A, I briefly summarise a number of projects related to my research but beyond the scope of this thesis, and these collaborations with young people, other doctoral students, educators and artists were highlights of my doctoral experience. Below I outline a series of potential contributions of this research, including methodological advances in speculative digital storytelling, theoretical contributions to environmental education based on theories of social practice, empirical evidence for hope-based pedagogies, and recommendations for education policy and practice.

6.3.1 Speculative digital storytelling

The first contribution of my research is methodological. The research in chapter five is the first example in the literature and the international community of digital storytelling that uses the tradition of digital storytelling developed and supported by the StoryCenter (see chapters two and five) to capture stories about the future for the purposes of research. As referenced above, the three threads that weave together this thesis are brought together in the research method of speculative digital storytelling. This method was fruitful for my research, with the participants also expressing appreciation for the experience, and the resulting stories feeding into further education and outreach efforts, including at COP26.

Digital storytelling is an established practice in community arts, international development, research and evaluation. The training I received from StoryCenter in facilitating digital storytelling workshops gave me the confidence to experiment with the process, shifting from personal reflection to speculation. The structure and simplicity of the digital storytelling process has advantages over more open-ended arts-based participatory research methods like participatory video and photovoice. Based on this research, I believe speculative digital storytelling can be broadly applied by geography and education to explore inner worlds of young people as

they relate to shared sociotechnical imaginaries across a wide range of research questions. I plan to continue using the speculative digital storytelling method in research and engagement projects.

6.3.2 Practice-informed whole-school sustainability

The second contribution of my research is theoretical. Chapter three reflects the integration of the theory of practice architectures with whole-school approaches for sustainability, a novel theoretical approach to environmental education and school sustainability given the continued influence of models of individual behaviour change. As my doctoral research has been in the School of Geography and the Environment, with my supervisors based in the Environmental Change Institute, this thesis grows from the interdisciplinary soil of geography and environmental social sciences. It is through this world that I was introduced to theories of social practice, and their application to questions of environmental sustainability. As I discuss in the introduction, this was an epiphany, exposing flaws in a half-century of environmental education, and decentring individuals in how I view the climate crisis.

This thesis builds on the work of Kemmis to connect social practices, practice architectures, and education for sustainability. Practice architectures offer an additional layer of analysis and action to whole-school approaches based on the context that enables or constrains more sustainable schools. This integrated theoretical perspective has practical applications in terms of policy and pedagogy. Without a more holistic approach to school transformation, programmes such as Eco-Schools can feel like a superficial box-ticking exercise. However, school eco-leads often meet resistance when applying whole-school approaches to sustainability. With the theory of practice architectures, researchers and practitioners are invited to investigate the sayings, doings, and relatings of school sustainability, and the semantic, material and relational arrangements that support more sustainable school practices. A holistic, practice-informed approach to education for sustainability promises to help educational institutions meaningfully decrease their environmental

impact while equipping learners with competencies related to understanding systems and participating in systems change.

6.3.3 Hope-based pedagogies in climate education

The third contribution of my research is empirical, in terms of both replicating previous research, and triangulating different disciplinary perspectives and methodologies to seek transdisciplinary insights. Chapter four describes the questionnaire completed by sixth form students and their teachers that incorporates a number of questions from related research, including previously developed and validated measurements of teacher practices and climate hope. This research replicated Ojala's study of Swedish teenagers, finding the same relationship between teacher practices and student-reported hope with English teenagers. This research also brought together aspects of related studies on climate hope and action competence, illustrating a clear relationship between these two concepts.

In terms of triangulation, the empirical insights from the questionnaire – quantitative data that could be analysed for correlation and statistical significance – were brought to life through the rich qualitative data of the speculative digital storytelling process, which were explored through narrative and reflexive thematic analysis. For example, the numerical ratings of the likelihood and desirability of positive and negative future scenarios were made possible by presenting written descriptions of the future in the questionnaire. And through their multimedia letters from the future, young people crafted and communicated their own future scenarios, which were then discussed in focus group conversations in terms of their filmmaker intentions and the impact of viewing the work of other students.

This theme of my research has coalesced around the concept of hope-based pedagogies in climate education – the teacher practices which support the development and maintenance of climate hope. As noted above, the speculative digital storytelling process is itself a form of hope-based pedagogy, inviting groups of young people to creatively, collaboratively describe futures feared and desired, and, through a process of positive reappraisal, develop agency and take action. I plan to

continue to explore hope-based pedagogies through research and public engagement activities, as described in the following section.

6.3.4 Implications for policy

The literature review in chapter two includes the policy framework for school sustainability and climate education in England, especially with respect to the Department for Education's 2022 strategy for sustainability and climate change. According to this strategy, every nursery, school and college should have a staff person that serves as the sustainability lead and receives carbon literacy training. In most schools, the sustainability lead will be a new position, dependent on resources and support from DfE, local authorities, and professional networks. As this support takes shape, it would benefit from two key elements of this research – the adoption of practice-informed whole-school approaches to sustainability by school leadership and governors, and the inclusion of hope-based pedagogies in the classroom.

Given the possibility of a change in leadership after national elections in late 2024, new education policies may soon be taking shape that go beyond the DfE strategy and substantially revisit the national curriculum and funding mechanisms. Changes to the national curriculum should follow the recommendations of the student-led Teach the Future campaign, and affirm that climate and sustainability are cross-cutting themes. Education policy needs to be aligned with the government's net-zero goals, with substantial increases in funding for retrofitting schools to improve energy performance, decarbonise heating, and invest in onsite renewables. Funding needs to be provided for staff time, especially sustainability leads, and to allow schools to bring in expertise related to energy management and sustainable procurement. The government should also support teacher training and continuing professional development to ensure that educators have the capacity to deliver climate education that covers cognitive, social-emotional, and behavioural aspects of learning about climate science, impacts, mitigation and adaptation.

In addition to the creation and implementation of government policy, this research has implications for the policies adopted by schools. With the wide

adoption of academies, and consolidation into large multi-academy trusts, the governance and leadership of these academies and multi-academy trusts is a key leverage point for school sustainability and climate education, especially if these issues were treated similarly to cross-cutting concerns such as safeguarding, equity and inclusion, and digital skills. In future research and public engagement activities, I plan to work closely with an Oxford multi-academy trust that has recently appointed a trust-wide environmental lead.

6.4 Looking backwards

The conclusion of my doctoral studies provides an opportunity to reflect back on this research with a different perspective from when the process began. Doctoral research requires a narrowing of focus to support both specialised training and the delivery of a discrete piece of scholarship. While necessary, decisions made over the course of the research close off other possibilities, and, in retrospect, can be understood as potential limitations and blindspots. This section offers a brief critical reflection, before turning to look ahead to future activities and research.

A major blindspot in this work is the lack of explicit discussions of power and justice in terms of the causes and impacts of climate change, as well as a lens to critically view proposed solutions to the climate crisis. Through the personal reflections of this thesis, and the conceptualisations of climate education referenced in the three papers, climate change can be understood through the interrelationship of geophysical, ecological and social (historic, political, economic) systems (Clark and Yusoff 2017). However, this analysis would have benefited from engaging more directly with critical, feminist, decolonial scholarship as it intersects with climate change and education.

For example, the lens of climate justice provides clarity in terms of diagnosing the problems that climate education must contribute to solving:

Climate justice approaches seek to expose the root causes of climate change to address and dismantle these systemic issues and structures in different ways. These include dismantling fossil fuel dependency, defetishization of endless capitalist growth on a finite planet, challenging

non-participatory democracy, resisting extractive exploitation of natural resources, confronting racial capitalism and Indigenous erasure, among other things (Sultana 2022, 119).

This thesis has also referenced the relational aspects of both practice architectures and climate solutions. This also would have benefited from more directly engaging with indigenous conceptualizations of climate justice, for example Whyte's identification of relational climate tipping points, in terms of the degradation of kinship, trust, consent and reciprocity (2020). This is echoed in a decolonial approach to climate education, and calls by Stein et al. (2022) to interrupt the denial of systemic colonial violence, ecological unsustainability, condition of entanglement, and the extent and depth of the problems we face, which stands in stark contrast to ideas of education for sustainable development.

In retrospect, another clear limitation of this thesis is geographic and demographic. The decision to focus much of this work on secondary schools in the southeast of England has resulted in empirical findings related to a small, relatively privileged population, which was only exacerbated by the number of private schools involved in this research. This narrow focus was in part due to adapting plans as a result of the coronavirus pandemic, as my initial research proposal included more broadly comparing the climate education across the four nations of the UK. However, were it possible to start again with the thesis, I would be very interested in finding some means of including populations in the Global South to broaden both the scope and impact of this work.

The methodology of digital storytelling provided an opportunity for the young people involved in this research to reflect critically and creatively on their own privilege and issues of climate justice. For example, their multimedia letters from the future explored how climate change – and proposed climate solutions – will impact people differently, with implicit critiques of capitalism, colonialism and racism. This reinforced the potential of digital storytelling as a research method and climate education intervention, and further research could explore this process with different groups of young people around the world. At the same time, such

an effort must critically engage with the concept of vulnerability, exploring our common but differentiated vulnerabilities and responsibilities, and responding to a call for compassionate climate change research (Eriksen 2022).

6.5 Looking forwards

Another objective of this chapter is to look ahead, both in terms of where my doctoral journey has taken me and the research directions I see for climate education and school sustainability. I started these doctoral studies after a 16-year career in digital communication for environmental organisations. While I still hope to incorporate filmmaking and storytelling in my work, and build on my experience with the evolving digital and social media landscape, this research reflects a new phase in my life, and a chance to bridge academic research, public communication, and practical support for educators. As I look ahead, I hope that I've developed the anticipatory competencies I call for above that help prepare learners (of all ages) for the future.

6.5.1 My future at Oxford

Early in 2022, my supervisor Tina Fawcett and I began to explore the possibility of convening researchers, students and staff from across the University of Oxford to discuss climate education. We received seed funding from the Social Science Division's Integrated Impact Fund to set up an informal Climate Education Lab, which held a workshop in May 2022 at the Oxford Department of Education, and supported a residential trip by students and teachers in the UK Schools Sustainability Network to Oxford University's research forest Wytham Woods. The Climate Education Lab is currently working on a project with the Oxford Gardens, Libraries and Museums (GLAM) and the Rumble Museum at Cheney School in which museum objects will be part of a multimedia digital trail called the Museum of Climate Hope.

Through my research and the Climate Education Lab (as well as the activities listed in Appendix A), I have developed relationships with people from across Oxford with similar interests. As a result, I was able to start as a research officer in November

2022 for a new interdisciplinary hub on the Future of Education and Training for the Climate (ETC) led by Steven Puttick at the Department of Education. Shortly after that, another opportunity arose to help implement the curriculum priority of the University of Oxford's environmental sustainability strategy to 'offer all students the opportunity to study environmental sustainability, either within or outside the examined curriculum'. In February 2023, I started as the curriculum project lead in the University Estates Services sustainability team and am working on the baseline research and liaising with stakeholders from across the University of Oxford to explore how to improve sustainability education, drawing on influences such as Sterling (2013) and Facer (2020). The combination of these two positions is a full-time post-doc extending into early 2024, building on my doctoral research on school sustainability and climate education, with applications both to the student experience and emerging interdisciplinary research at the University of Oxford.

6.5.2 Future research

In all three of the papers above, I mention future directions for research building on the findings and limitations of the articles in this thesis. As opportunities arise to shape the research plans for the Future ETC Hub, and as I prepare proposals for funding aimed at early career researchers, I will likely incorporate one or more of these research questions. I also hope other members of the climate education and school sustainability research community pick up on these research themes to further our understanding of how schools can contribute to climate solutions, adaptation and resilience.

In chapter three, I explored how the lens of social practices and practice architectures could lead to insights into the opportunities and barriers for more sustainable schools, complementing whole-school approaches to sustainability. However, for the most part this research was undertaken remotely through interviews and focus groups conducted via video conferencing software. Future researchers could also investigate school practices, but through a longer-term, observational approach at a

smaller number of schools, for example using sensory ethnography to identify social practices and practice architectures, and their dynamic, dialectic relationships.

When sharing the article in chapter four, I often focus on the teacher practices that correlated with climate hope, as that is an actionable message for educators. The practices covered by the questionnaire come from previous research by Ojala, and reflect a range of ways teachers can relate to their students and frame climate education in the classroom. I see an opportunity to work with teachers to revisit this list of practices based on emerging pedagogies and desired learner outcomes and competencies. A new survey could be developed and validated to measure the relationships between this new set of proposed practices and concepts such as climate anxiety, which has also been the focus of much research over the past few years.

Chapter four also includes an initial attempt to bring together the themes of teacher practices, positive and negative emotions, and climate action into a single mediation model. I believe there is more to explore both theoretically and empirically in terms of the relationship between different forms of education and climate hope and anxiety in learners, and also the relationship between hope and anxiety and climate action. To fully explore these ideas – especially in a social practice- and practice architecture-informed manner – would require a larger scale research project, possibly involving the testing of interventions or a longitudinal study.

As mentioned above, I also plan to continue exploring hope-based pedagogies and using the method of speculative digital storytelling, and I look forward to identifying new opportunities to collaborate with researchers working across disciplines to rethink education in the climate crisis. This effort is currently underway through Museum of Climate Hope project, which I am very excited about further developing and expanding as a postdoctoral project.

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And so we find ourselves, all of us together, poised trembling on the edge of a change so massive that we have no way of gauging it. None of us knows where to look, but all of us know not to look down. Secretly, we all think we are doomed: even the politicians think this; even the environmentalists. Some of us deal with it by going shopping. Some deal with it by hoping it is true. Some give up in despair. Some work frantically to try and fend off the coming storm.

Our question is: what would happen if we looked down? Would it be as bad as we imagine? What might we see? Could it even be good for us?

Paul Kingsnorth and Dougald Hine in *Uncivilisation: The Dark Mountain Manifesto*

7

Conclusion

Ten years ago, having relocated from Vermont to the UK, I found myself exploring the environmental landscapes and movements of my new home. At this point I discovered the Dark Mountain Project, a collection of writers and artists engaged in storytelling about this time of polycrisis and the roots of these crises in our fraying relationships with each other and the natural world. When I read the Dark Mountain Manifesto (Kingsnorth and Hine 2009), quoted at the beginning of this chapter, I felt that some of my darkest fears had been beautifully articulated.

In workshops with students, I often reference the quote by speculative fiction writer William Gibson: ‘The future is already here, it’s just not evenly distributed’. While sometimes presented in terms of the futuristic technology to which some people already have access – and the rest of us must obviously envy – I see this as reflecting the future many of us fear about climate change. The climate crisis is already here, and it isn’t evenly distributed. There is no cliff that we will fall off in 2030 or 2050. No clock that will run out, nor a referee who will tell us if we have won or lost. Loss and change, unravelling and rebuilding – we are witnessing and experiencing these things, although some of us are much more protected and less precarious. The challenge for climate educators is to help learners understand and navigate this time of change. To look past climate change as simply a problem to be solved, and see, in the midst of the unfolding tragedy of loss and

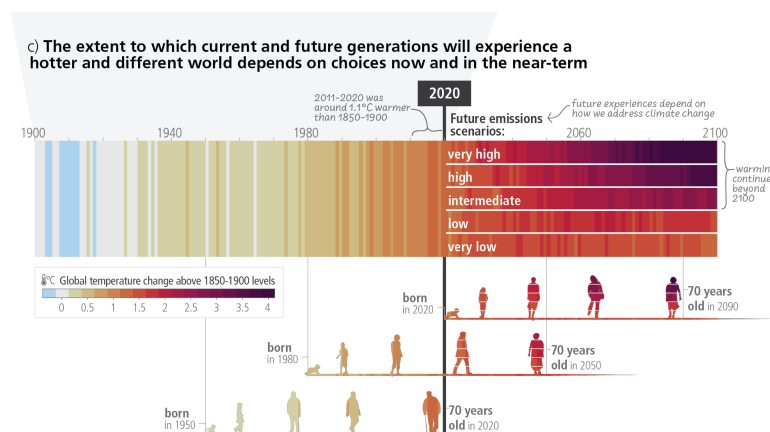


Figure 7.1: Historic climate stripes and future scenarios experienced by different generations (SPM.1(c) in IPCC 2023)

suffering, an opportunity for what Joanna Macy calls the ‘great turning’ into a more sustainable relationship with people and place.

While I’ve been writing this thesis report, the Intergovernmental Panel on Climate Change released the Synthesis Report of the Sixth Assessment Report, the latest summary of our scientific understanding of the physical science of climate change; climate impacts, adaptation and vulnerability; and the mitigation of climate change (IPCC 2023). One of the visuals included in the Summary for Policymakers combines the climate stripes referenced in chapter one with future emissions/warming scenarios, placed in the context of how different generations will experience these possible futures (Figure 10). This report – representing the work of hundreds of scientists synthesising thousands of academic papers – allows us to look backwards and forwards, situating us in the middle of centuries of change, reminding us that we are shaping the future, for better or worse.

While completing the digital storytelling training course offered by the Story-Center, I decided I should give myself the same assignment that I planned to give sixth form students: write a letter from your future self in the year 2050 to your current self, and turn it into a short video. I used the same video editing software as the workshop participants, and tried to limit myself to the same time I allotted for writing and editing in the workshops. My digital story¹ described a

¹The digital story ‘Staying with the Trouble’, which I created through the StoryCenter training, is available at <https://www.youtube.com/watch?v=TxNgB3cHVnI>.

future of loss and change, abandonment of farms and the disintegration of political institutions. But, somehow, putting this all into words, while also describing a return to localism and rewilding of landscape, made me feel less worried about the future. By ‘looking down’ and facing the future, I was able to tell a story that felt true, but reflected survival, adaptation and resilience. The speculative storytelling process was cathartic and left me hopeful.

This process of positive reappraisal of the climate emergency echoes Rebecca Solnit’s call for ‘hope in the dark’ and the reflections of Dark Mountain co-founder Dougald Hine in a short documentary I produced on climate change and the stages of grief². When we see clearly the situation we are in and the possibilities of where we are going, when we let our eyes adjust to the dark, the undying, flickering embers of hope become visible, and we can better see the stars to guide our journey.

²The short documentary ‘After Denial: Coping with climate in five acts’ is available at <https://stories.350.org/after-denial/>.

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Appendices



Additional Activities

While the core academic outputs of this doctoral research are included in the main body of this document, additional activities that contributed to my postgraduate experience are summarised briefly below.

26k Climate Conversations

Leading up to COP26, I was part of a team of Oxford students and recent graduates that created a campaign and website platform to support people talking about climate change, with the goal of 26,000 conversations shared by COP26. I served as the education lead, developing materials to support teachers and sharing the campaign with the global environmental education community. An article based on this project was recently published in Climatic Change.

Website: <https://talkclimatechange.org/>

Article: <https://doi.org/10.1007/s10584-023-03493-5>

The Alan Turing Institute

In 2022, I joined the Alan Turing Institute, the UK research institute for data science and AI, as a doctoral enrichment student. Through this experience I received training in research software engineering and digital humanities. I also was an active member of the Turing Data Stories project, and conducted data storytelling workshops with three London secondary schools on air quality and energy data.

Website: <https://www.turing.ac.uk/research/research-projects/turing-data-stories>

BBC Ideas

In 2020, I produced a short film about being a good ancestor with the founders of the Long Time Project for the BBC Ideas website. The documentary includes interviews with indigenous leader Loretta Afraid of Bear Cook, artist Katie Paterson, and Sophie Howe, the Future Generations Minister for Wales. This video was added to the Sustainable Thinking playlist, which also includes a short film I produced with the Rapid Transition Alliance.

Video: <https://www.bbc.co.uk/ideas/videos/do-we-need-to-re-e-think-our-ideas-of-time/p0818lnv>

The Conversation

In 2020, I wrote a series of articles for the news website the Conversation, which publishes academic writing for general audiences. The articles explored the shift to digital climate activism during the Covid-19 pandemic, principles for home-learning about climate change during school closures, and the importance of government investments in more sustainable schools.

Articles: <https://theconversation.com/profiles/william-finnegan-960066/articles>

Cumberland Lodge

In 2021, I served as a research associate at Cumberland Lodge for their virtual conference Climate Futures: Youth Perspectives. My role involved producing a briefing paper in advance of the event and a final report with recommendations from the young people involved in the conference. The report launch was part of the youth-focused pre-COP26 All4Climate programme.

Report: <https://www.cumberlandlodge.ac.uk/read-watch-listen/climate-futures-youth-perspectives-cumberland-lodge-report>

Global Climate Research Portal

Working with other doctoral students, I supported the technical development of the Global Climate Research Portal, an open data portal of doctoral research related to climate change. The concept began as a pitch for the Oxford Foundry

All-Innovate 2020 competition, and a beta version of the website was launched with support from Somerville College in 2022.

Website: <https://theclimatelink.org/>

TORCH Climate Crisis Thinking Network

In advance of COP26, I helped organise and moderate two panel discussions of the Climate Crisis Thinking Network at the Oxford Research Centre in the Humanities. A virtual event explored how the education system can respond to the climate crisis, and included a number of researchers at Oxford as well as Arjen Wals and Rahul Chopra. An in-person event on storytelling about the climate and nature crisis at the Oxford Museum of Natural History profiled collaborations between scientists and artists.

Website: <https://www.torch.ox.ac.uk/climate-crisis-thinking-in-the-humanities-and-social-sciences#tab-3213496>

Training, conferences and other events

Over the course of my doctoral studies I also took advantage of many opportunities for training and to share my research at academic conferences and other events.

13/11/20: Presentation at the Youth Climate Summit (virtual)

19/11/20: Digital Storytelling Online Certificate Program (virtual)

25/02/21: Presentation at a SoGE DPhil Training Session (virtual)

04/03/21: Presentation at the St Antony's Research in Progress Colloquium (virtual)

21/06/21: Presentation at the International Digital Storytelling Conference (virtual)

30/07/21: Digital Humanities & Research Software Engineering Summer School (virtual)

17/08/21: Grant received from The Climate Coalition (Letter from the Future animation)

01/09/21: Presentation at the RGS-IBG AC2021 (virtual)

07/10/21: Poster at the NAAEE Research Symposium (virtual)

01/11/21: Moderated TORCH COP26 panel (virtual)

10/11/21: Presentation at the Transform Our World Youth Summit (virtual)

10/11/21: Organised TORCH COP26 panel

- 02/12/21: Presentation at a SoGE DPhil Training Session
- 28/01/22: Presentation to the SoGE Participatory Research Group (virtual)
- 18/03/22: Presentation at the World Environmental Education Congress (virtual)
- 07/04/22: Presentation at the Purdue ESE Symposium (virtual)
- 07/06/22: Poster at the eceee Summer Study on Energy Efficiency
- 28/06/22: Presentation at the Oxford Consortium for Human Rights
- 11/10/22: Panellist at the NAAEE Research Symposium
- 28/03/23: Presentation at the Oxford Consortium for Human Rights



Speculative Digital Stories

In advance of COP26, I approached eleven participants in the digital storytelling workshops that had consented to share their letters from the future with attribution and asked them to write short filmmaker statements. Their videos and accompanying statements were included as digital assets in the UK Schools Sustainability Network's Pupil Power Roadshow in the Green Zone exhibition space in Glasgow, and shared through a pop-up exhibition at the Oxford University Museum of Natural History at an event through the Oxford Festival of Social Science and the TORCH Climate Crisis Thinking in the Humanities and Social Sciences network. The links below are to unlisted YouTube videos of their digital stories preceded by their filmmaker statements.

1. **Omar Amin, Birmingham, UK**

Digital story: <https://youtu.be/gquebN1XRbM>

2. **Nikash Chekuri, Birmingham, UK**

Digital story: https://youtu.be/5Wni_DYA1aQ

3. **Tiger Darling, Brighton, UK**

Digital story: <https://youtu.be/ryHfMhxH7hA>

4. **Mila Kalbreier, London, UK**

Digital story: <https://youtu.be/Bb40gJkGH48>

5. **Ava Lang, London, UK**

Digital story: <https://youtu.be/E82QsEr2tvY>

6. **Tisa Maunder-Bushell, Berkshire, UK**

Digital story: <https://youtu.be/UL3717EqSLw>

7. **Ruth Mills, Berkshire, UK**

Digital story: <https://youtu.be/WWYdE9wxtSk>

8. **Matthew Murray, County Waterford, Ireland**

Digital story: <https://youtu.be/hRuFlTGh4o0>

9. **Elisabeth Rieger, Worcestershire, UK**

Digital story: <https://youtu.be/1gulK9kWMlI>

10. **Tan-Yi Stringer, London, UK**

Digital story: <https://youtu.be/-OQVuPi9DOM>

11. **Lucy Summers, London, UK**

Digital story: <https://youtu.be/xtpUL0BM0xI>