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Teaching climate change and sustainability in England: committed individuals and the prevalence of 'self-taught' professional learning

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ABSTRACT

This paper provides fresh insight into the nature and extent of teacher professional learning focused on climate change and sustainability in England. An analysis of the qualitative and quantitative data from a survey of teachers ($n = 870$) suggests that there is a cohort of committed individuals who recognise the importance of incorporating these topics into their teaching practice, but that the most common type of climate change and sustainability-related professional learning is 'self-taught'. In a context where meaningful educational responses to environmental and climate emergencies have been hampered by policy shortfalls over a prolonged period and where the need for responses is increasingly urgent, the results indicate that school students are reliant upon individual teachers choosing to incorporate these issues into their subject teaching and teaching themselves how to do so. We explore how incorporating 'self-taught' approaches into established frameworks of professional learning could enhance future work to support teachers. Opportunities to strengthen current practice centre on supporting new initiatives focused on collegiate professional learning, engaging with external experts, and policy change. We argue that these are essential if more teachers are to have the knowledge, skills and confidence to incorporate climate change and sustainability into their teaching.

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Teachers; professional learning (PL); teaching for climate change and sustainability; communities of practice; self-taught

Introduction

It is becoming increasingly clear that every sector of society, including education, must respond to climate change and contribute towards a more sustainable future. Schools play a central role in building young people's understanding of the interconnected environmental and social issues that are defining our time and developing their capabilities to respond (UNESCO 2023). In England, which is the focus of this study, the National Curriculum concentrates these topics narrowly within geography and science,

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and the latest Department for Education (DfE) sustainability and climate change strategy envisages professional development for science teachers only (DfE 2022). This situation resonates with analyses of other comparable contexts, for example, in Canada, where 'gaps and silences' have been found in environment and sustainability policy and curriculum (Aikens and McKenzie 2021, p. 77), and in Australia, where the National Curriculum has been criticised for a 'relative invisibility of climate change' (Beasy *et al.* 2023, p. 1680).

In parallel, Kennedy (2022) underlines the implications of urgent climate and ecological crises on teachers' professional learning (PL), noting the 'age-old challenge of educators translating personal and professional beliefs about teaching for justice and democracy into actual practice' (2022, p. 1). To date, research with teachers has identified an appetite for enhancing schools' response to climate and ecological crises (Liu *et al.* 2015, Howard-Jones *et al.* 2021, Dunlop and Rushton 2022), a phenomenon that is supported by wider polling of teachers' views and perspectives in England (SOS-UK 2022, Teach the Future 2022, Reboot the Future 2023) and elsewhere (Beasy *et al.* 2023). Yet, little is known about the nature and scope of PL that teachers access to help them incorporate climate change and sustainability into their teaching, be that informal independent or collegial practice, or their participation in specific activities and programmes (Li and Krasny 2019).

This paper contributes to that knowledge gap, by drawing on an analysis of findings from a recent survey of 870 teachers in England that set out to investigate the extent and nature of teachers' professional learning focused on climate change and sustainability and what types of support would help teachers to incorporate these topics into their teaching practice. To situate our study, we consider ideas and models of teacher professional learning before introducing the context of climate change and sustainability-related teacher professional learning in England.

Teacher professional learning

It is widely understood that teacher professional learning can contribute to more effective teaching and learning, a view which has been confirmed by numerous studies (Pollard 2007, James and Pollard 2011). Following Pollard *et al.* (2023), we distinguish between professional *development* as 'activities, or episodes of professional learning' (Pollard *et al.* 2023, p. 506) and adopt the broader notion of professional *learning* to describe what occurs across the life of the teacher: the 'totality of a set of individual professional development experiences' (Pollard *et al.* 2023, p. 507). Professional learning can encompass a broad range of activities including formal training, collegial and collaborative work, coaching, online and blended learning, and individual reading and reflection (Cirkony *et al.* 2024), all of which might be appropriate in different circumstances. These activities are helpfully captured along a 'spectrum of continuous professional development' by (Kennedy 2014, p. 349) which identifies nine models of professional development, grouped into three purposes, which all work towards increasing teacher capacity for professional autonomy. Briefly, the first group (e.g. training, award-bearing, and deficit models, the latter of which are designed to tackle a perceived shortfall in teacher performance) are aligned to the purpose of 'transmission' which 'prepares teachers to implement reforms' (p. 349). The third group has a 'transformative' purpose

that entails 'supporting teachers in contributing to and shaping education policy and practice' (p. 349) and encapsulates action research and transformative practices undertaken in context. Between these categories is Kennedy's second group of models, labelled as 'transitional', which can operate in support of either a transmission or transformative agenda (standards-based model, coaching/mentoring model, community of practice model). The capacity to enhance teachers' autonomy increases towards the 'transformative' end of this continuum. The principal aim of Kennedy's framework is to demonstrate how the different forms of professional learning align with different purposes, with a potential role for all models at different times. Thus, although transmission models are typically decontextualised and position the teacher as a passive participant and, working alone, they may be less effective in generating change in teachers' practice, they can be a useful way to introduce new knowledge. An important implication of Kennedy's work, however, is a need for greater awareness about what different forms of professional learning can and cannot achieve in terms of teacher autonomy and efficacy.

Recent meta-analyses of the characteristics of effective professional learning, e.g. (Timperley 2008, Cordingley *et al.* 2015, Cirkony *et al.* 2024), take a slightly more fixed approach to defining what models 'work'. A recent example of these is a rapid review by Cirkony *et al.* (2024) which synthesises 12 predecessor analyses. The authors identify eight features of effective professional learning: (1) collaboration; (2) active learning and reflection; (3) content and pedagogy in context; (4) sustained duration; (5) coaching; (6) external expertise; (7) modelling; and (8) audience and alignment (Cirkony etal., 2021). Additional considerations for effective professional learning that were also highlighted included workplace conditions, effective professional learning providers, and online and blended learning contexts.

Lists such as these make much sense theoretically. However, listing characteristics separately can mask the fact that they often overlap in practice in ways that suit particular contexts and purposes. For example, professional learning which is collaborative and linked to action learning and reflection is likely to be present in school-based action research projects where teachers work together to explore a particular aspect of their practice over an extended period (Merriam *et al.* 2007, Knowles *et al.* 2015). Such overlaps are evident in evaluations of sustainability and climate change focused professional learning. For example, a study of the long-term effect on self-efficacy of a sustainability-related teacher professional development programme in Sweden (Boeve-de Pauw *et al.* 2022) signals the importance of *sustained duration* and *content and pedagogy in context*. They identified fluctuations in self-efficacy over time and in response to experiments and thus advocated for professional development that creates long-term opportunities for practice. In the US, Redman *et al.* (2018) evaluation of a sustainability teacher professional development programme signals the importance of: *active learning and reflection* through 'real-world, hands-on, solutions-oriented activities' (p. 74); *audience and alignment* through a 'whole programme and whole person approach' (p. 75); and *modelling* sustainability through their programme to demonstrate that 'sustainability leadership involves becoming a role model for sustainability personally, in society, and professionally' (p. 76). Similar features are also emphasised in studies focused on sustainability in initial teacher education (ITE). For instance, a transdisciplinary 'living laboratories' teacher education programme in Germany (Bürgener and Barth 2018) emphasises the centrality of participatory processes in societal

transformation, and teacher education which focuses on experience-based problem-solving, and encourages action, platforms for exchange, experimentation in practice (p. 825). Their recommendations chime with the characteristics of *collaboration, active learning and reflection*, *content and pedagogy in context*, and *audience and alignment*. Others offer insights for creators of online materials, such as an online environmental education course for pre-service teachers in Australia (Siegel and Blom 2025).

Lists such as Cirkony *et al.*'s (2021) have been criticised for attributing too much certainty to agreed features of effective professional learning, or for implying that there is a 'a one-size-fits-all answer to the question of what professional development approach is more or less effective' (Asterhan and Lefstein 2023, p. 17). Kennedy, in contrast, recognises that such features may differ depending on the purpose of the professional learning being undertaken (Kennedy 2014). Nevertheless, if we compare the features of professional learning most likely to lead to 'transformation' in Kennedy's spectrum of CPD Models with Cirkony *et al.*'s (2021) list of the characteristics of effective professional learning, we can see some commonalities, for example, action research approaches. This can provide a helpful touchstone to designers of sustainability and climate change-focused professional development to consider why a programme might be effective (or not), and which features could be amplified in a programme to boost effectiveness.

Climate change and sustainability in the curriculum and associated teacher professional learning in England

Responsibility for education is devolved across the four jurisdictions of the United Kingdom (UK): England, Scotland, Wales and Northern Ireland. Education in England, the focus of this study, is overseen by both the Department for Education (DfE), which mandates the National Curriculum, and by two non-ministerial government departments: Ofqual (The Office of Qualifications and Examinations Regulation) which regulates the examinations student take and Ofsted (The Office for Standards in Education, Children's Services and Skills) which inspects school and other education institutions (Rushton *et al.* 2025). In England, climate change and sustainability are predominantly taught as part of secondary science (compulsory for 11- to 16-year-olds) and geography (compulsory for 11–14-year-olds) (Howard-Jones *et al.* 2021, Dawson *et al.* 2022) but the way that these topics are addressed in the secondary curriculum remains contested. Some scholars argue that the socio-economic impacts of climate change are only marginally considered, and that there is inadequate engagement with political, social justice and action-oriented dimensions (Howard-Jones *et al.* 2021, Dawson *et al.* 2022, Dunlop and Rushton 2022). In April 2022, after sustained policy silence, the UK government published the non-statutory strategy entitled 'Sustainability and climate change in the education and children's services systems' (DfE 2022). The strategy articulates a government commitment to giving 'every teacher and school leader access to world class training and development opportunities'; however, on closer inspection, it offers limited tangible support to teachers, with a promise to 'include climate change and sustainability in *science* teachers' continuing professional development (CPD)' (n.p.) (italics added). Such relatively meagre professional learning commitments reinforce narrow interpretations of the teaching that is needed in response to the climate crisis, limiting it to a concern for science education and science teachers.

Given this context, it is perhaps unsurprising that despite many teachers' appetite for enhancing schools' responses to climate change (e.g. Howard-Jones *et al.* 2021), the evidence suggests that teachers are also struggling to find opportunities to engage in relevant professional learning. For example, a survey by Teach the Future (2021) (n = 7682) found that '70% of teachers [felt] they have not received adequate training to educate students on climate change . . . ' (2021, p. 2) and a majority of respondents in the Reboot the Future study (n = 195) reported that they lacked the training to teach 'sustainability-related topics' (2023, p. 14). Howard-Jones *et al.* (2021) similarly argued that teachers need more support to enact an action-oriented climate change curriculum. Such shortfalls are not unique to England. For instance, a Croatian study (Anđić 2020) describes teacher professional development in Education for Sustainable Development as 'most often perceived as insufficient and incoherent for the past 10 years' (p. 148). Their survey of primary teachers (n = 1096) identified a reliance upon 'independent learning – self-study, rather than systematic education or organized professional development' (p. 159). However, there are several impediments to the provision of such professional learning in England, not least the frameworks which interact to create the policy landscape within which schools and teachers operate. Alongside the National Curriculum, this landscape includes: Teacher Standards (DFE 2011) that influence teachers' practice and conduct; a Core Content Framework (DfE 2019a) that guides ITE; an Early Career Framework (DfE 2019b) that supports teachers during their first two years of service; and national professional qualification courses (DfE 2020). These frameworks lack explicit mention of concepts related to climate change and sustainability (Rushton *et al.* 2024) with the result that their inclusion is left to the discretion of training providers and practitioners in schools.

In order to design and target support where it will be most effective, there is first a need to develop our understanding of the extent and nature of current professional learning that focuses on climate change and sustainability. Accordingly, the survey we report on here, undertaken prior to the full implementation of the DfE strategy (2022), was guided by the following research questions:

(1) What is the nature and extent of professional learning related to climate change and sustainability that teachers have participated in?
(2) Based on the above, how could professional learning more effectively support teachers to incorporate climate change and sustainability into their teaching?

Methods

In view of the policy challenges, and the gaps in the literature that we identified above, we report on findings from an online survey which investigated teachers' views and experiences related to climate change and sustainability in England. The findings presented below extend and develop those from our initial analysis (Greer *et al.* 2023) and focus specifically on professional learning.

BOX 1. Questionnaire items that are incorporated into the analysis presented in this paper

Q1.Which of the following statements best describes your teaching practice related to climate change and/or sustainability? (Items adapted from Howard-Jones *et al*. 2021) (Select Never/Almost never/Sometimes/Often from a list of sub-items)

Q2. In which subject(s) do you include climate change and/or sustainability in your teaching? (Select Most commonly/Sometimes/Rarely from a list of the subjects that are included in the National Curriculum, GCSE and A-Level)

Q3. Have you participated in any professional development that relates to climate change and/or sustainability in a specific subject or more generally? (Items adapted from Pettigrew *et al.* 2009) (Select Yes/Not sure/No across a range of sub-items)

Q4. Could you briefly describe any recent professional development that you have participated in that has helped you to incorporate content and practices related to climate change and sustainability into your teaching (Free text field)

Q5. What types of support would be most helpful for enhancing the quantity and quality of your teaching related to quality climate change and sustainability? (Select top 5 from a list of options)

Q6. The next set of questions invites you to think about professional development that would help you incorporate climate change and/or sustainability into your teaching:

a. What mode of delivery would you prefer? (Online live/Online pre-recorded/In-person)

b. When would you like to participate in this professional development? (During school hours/After school hours/Evenings/At my own pace)

c. Where would you like to participate in this professional development? (At my school/At another school nearby/At University College London (Central London)/At home)

d. What format would you like this professional development to take? (Interactive workshop/Conference-style/Training modules/Webinars)

e. What frequency would you prefer for this professional development? (One off/Multiple sessions/Ongoing)

Questionnaire

The questionnaire was designed using a collaborative process, which involved four cycles of drafting, team discussion, literature review, testing and peer review, followed by two pilot studies. The questionnaire was administered through Qualtrics software and it took approximately 20 minutes to complete. It included 38 items arranged in four sections: i) conceptions of climate change and sustainability, and related education; ii) teaching practice related to climate change and sustainability (subjects taught, frequency, specific practices); iii) professional learning related to climate change and sustainability (the focus of this paper – see Box 1); iv) demographic information. Given that the focus of the research was to investigate teachers' experiences, more so than to analyse who the respondents were, and mindful of non-completion rates, we placed demographic questions in the final section.

Participants

Teachers from all school stages and all subject areas from across England were invited to complete the questionnaire between October and December 2022. Participants were recruited via electronic invitations issued through our Faculty and research centre distribution lists, social media channels, and through e-newsletters and articles. Other organisations, e.g. subject associations and teacher unions, were invited to promote the

survey to their networks. An incentive was offered in the form of two randomly drawn cash prizes for climate change and sustainability-related teaching resources.

The final cleansed data set comprised responses from 870 teachers and headteachers. Participants were not required to complete every item and the final section of the survey was answered by between 508 and 550 respondents, rather than the full 870. Of those, the majority identified as female ($n = 388$, 74%) and white ($n = 467$, 91%). Their years of teaching experience ranged from 1 year to 20+ years, and routes into teaching were dominated by university-led ITE programmes ($n = 306$, 87%). The respondents taught across England's school system, most commonly in academies (n = 201, 36.5%), local authority-maintained schools ($n = 161$, 29.2%), and private (independent) schools ($n = 87$, 16%), with the majority teaching at secondary level ($n = 359$, 70.7%), and just over one third at primary level ($n = 176$, 34.6%).

Analysis

Several data analysis methods were used. Analysis of Q1 and Q2 (see Box 1) involved calculating percentages based on the frequencies that teachers reported incorporating climate change and sustainability into their teaching. Analysis of Q3 involved cross tabulation between participation in professional development related to climate change and/or sustainability and the specific subjects that teachers taught (see Appendix). We elaborate on the statistical analysis with findings identified through thematic analysis of the Q4 open-text responses, a process comprising data familiarisation, inductive coding, identification and review of themes relative to the statistical analysis, defining and naming themes, then writing the findings as an iterative process which involved returning to the original data, the statistical analysis and the literature (Braun *et al.* 2018). We present the themes with the support of illustrative examples of professional learning experiences that teachers shared. Analysis of Q5 involved calculating the most commonly selected priorities by summing all responses, then calculating a percentage across the number of respondents. Finally, ranked preferences were used to identify the types of professional development that teachers sought (Q6a-e).

The research was guided by the British Education Research Association (BERA) Ethical Guidelines for Educational Research (BERA 2018) carried out with the approval of our university's ethics review committee (REC 1627) and data was managed in accordance with the UK GDPR and DPA 2018. Participation was voluntary, and responses were anonymised prior to analysis.

Limitations

The following findings can be viewed as reflecting the views of the teachers who participated in the survey, and of an engaged cohort of teachers in England, rather than being generalisable to the wider teaching workforce. That is, this sample includes 0.03% ($n = 161$) of the 470,000 teachers who work in state-funded schools (based on the 2023 School Workforce Census (DfE 2024a)). Hence, as a voluntary survey about an (at times) polarising topic, it is likely that the responses were biased towards teachers who are already engaged in teaching about climate change and/or

sustainability. Future research investigating the views and experiences of those who are less engaged in teaching about climate change and sustainability would make a valuable contribution to the literature, although we recognise the difficulty of engaging with such individuals.

Findings

The nature and extent of teachers' professional learning experiences

Teachers were asked to indicate the types of professional learning related to climate change and sustainability they had participated in. Most notably, 71% of teachers reported that they had taught themselves how to incorporate climate change and sustainability into their teaching (Figure 1). A much smaller proportion (31%) reported that they had taken part in related professional development offered by organisations from outside their school, while almost one quarter (24%) of the participants reported that they had participated in professional development activities which were provided in-school.

Also of note was that only a small proportion (13%) of the survey respondents indicated that these topics had been a focus within their ITE, chiming with a pan-European study (Dahl 2019) which found that teachers leave teacher education programmes less prepared to educate for sustainability than other aspects of teacher professionalism. This might be a significant result, given the prominence of geography and science teachers in the sample, although it does not describe the state of current ITE provision given that the years of teaching experience ranged from one to 20 + . Research to investigate how climate change and sustainability are currently incorporated into ITE

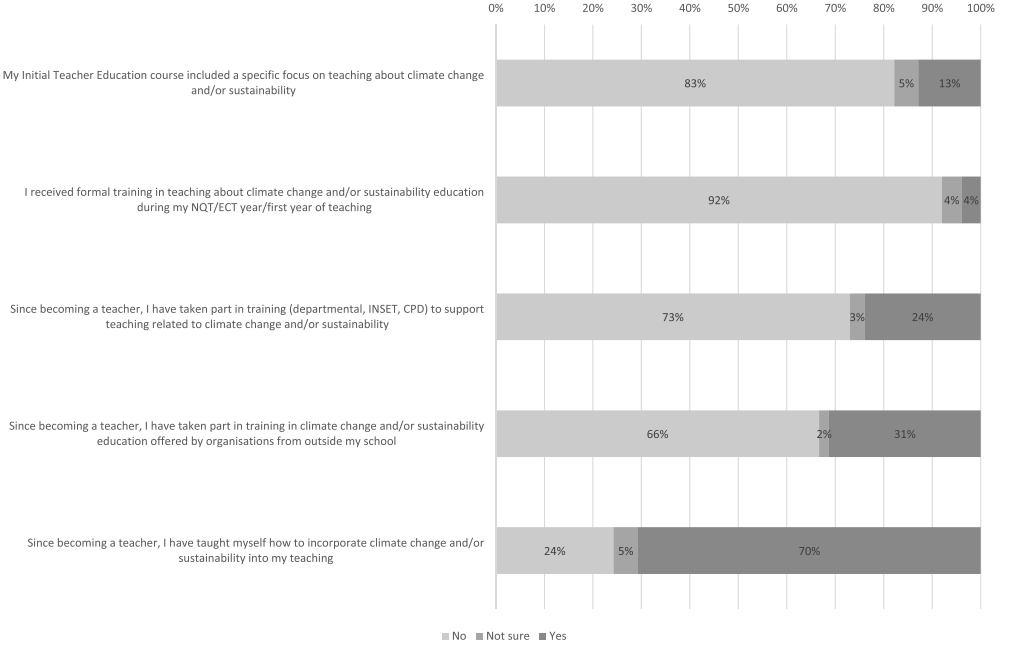

Figure 1. Participation in types of professional learning related to climate change and sustainability education.

programmes across England and with what effect would be worthwhile and would sit alongside international studies (e.g. Bourn *et al.* 2023; Mula and Tilbury 2025). In the meantime, where ITE is not preparing teachers to incorporate climate change and sustainability into their teaching, the case for effective professional learning for in-service teachers is strengthened (Redman *et al.* 2018, p. 59).

Teachers of citizenship and geography were most likely to have experienced professional learning related to climate change and/or sustainability, with informal and self-taught approaches being most common (citizenship 85%; geography 72%), followed by in-school professional learning (citizenship: 30%; geography 31%) or training offered by external organisations (citizenship: 39%; geography 44%) (Table 1). Surprisingly, perhaps, teachers of science reported lower levels of engagement in organised activities than did teachers of citizenship and geography, and less than several other subjects for which these topics are not in the core curriculum. Beyond that, as Table 1 shows, the trends in professional learning were largely consistent across subjects with 'self-taught' being by far the most common type, followed by that which is delivered by external organisations, then that which is delivered in-school.

Exploring these results further, we reflected on the examples of professional learning experiences that were shared by teachers ($n = 260$) and, applying deductive thematic analysis methods, identified four predominant types of professional learning, rather than the three that were designated in the survey: self-taught, informal collegial learning (the additional type), activities organised by schools or multi-academy trusts, and activities led by external providers. While the above analysis provides insight into the extent of relevant professional learning, the illustrative examples offered below further elucidate the nature of each type.

Self-taught professional learning

As Figure 1 indicates, the majority of respondents in our survey taught themselves how to incorporate climate change and sustainability into their teaching. Corresponding with this result, informal, 'self-taught' activities were prevalent amongst the open-text

Table 1. Professional learning experiences by subject.

	Self-taught			Delivered by external experts			Organised by school/trust		
Subject	No or not sure	Yes	% Yes	No or not sure	Yes	% Yes	No or not sure	Yes	% Yes
Citizenship	9	52	85%	37	24	39%	43	18	30%
Geography	58	152	72%	117	93	44%	145	65	31%
Art and Design	46	113	71%	106	52	33%	126	32	20%
Science	55	133	71%	131	57	30%	147	38	21%
Design and Technology	39	81	68%	75	45	38%	92	28	23%
PSHE including tutor/form time	57	122	68%	118	60	34%	133	46	26%
English/Literacy	53	105	66%	109	49	31%	126	32	20%
Music	29	59	67%	59	29	33%	70	18	20%
Religious Education	42	79	65%	81	40	33%	94	27	22%
ICT or computing	37	67	64%	66	37	36%	82	22	21%
Physical Education	39	60	61%	65	34	34%	76	23	23%
History	53	84	61%	93	44	32%	107	30	22%
Modern Foreign Languages	30	47	61%	56	21	27%	63	14	18%
Mathematics/Numeracy	63	92	59%	109	45	29%	126	29	19%

responses. These responses included descriptions of self-taught professional learning that were linked to classroom practice, for example:

> I have completed COP26 poetry writing with students in which I personally had to revise and revisit learning and statistics regarding climate change in order to effectively teach it.

Most common amongst these responses were descriptions of reading and viewing, with typical responses as follows:

> I have read a lot. I have basically educated myself.

> Just listened to news.

> None, unless you consider documentaries and reading scientific articles as professional development for a science teacher.

Rather than engaging with education-specific material, respondents described engaging with academic and non-academic published materials to build content knowledge. These sorts of activities might be expected of any professional who wants to build or deepen understanding in a field of knowledge, and for teachers to ensure the relevance of the taught curriculum. Yet, teachers' experiences of 'time poverty' (Creagh *et al.* 2023) in their work means that it is likely to be a minority who can systematically engage with the evolving literature on climate change and sustainability, including that which explores subject-specific pedagogy.

Informal collegial professional learning

A second group of responses highlighted a propensity for professional learning which occurs informally amongst colleagues. While the survey asked teachers to select the types of professional learning they had participated in (ITE, in-school formal, external providers, or independent learning), it was noteworthy that many of the descriptions coalesced under a theme of informal collegial professional learning. These included examples of learning with colleagues from other schools:

> As eco-lead . . . I attend (online) meeting with eco-leads in other local schools.

> I am a member of a London School Eco Network - this has been invaluable in providing information on how to do this.

Membership of UKSSN[1] has been really useful.

> I have not been on any CPD but have learnt a lot by being active in the NEU[2] and becoming part of the NEU climate change network as well as being involved in local campaign groups.

Respondents also provided numerous examples of informal collegial professional learning in school:

> Liaising with colleagues on resources they have developed. Enhancing these resources based on experience of delivering/using them in lessons.

> We have recently undertaken an audit in school exploring where and how climate change issues are incorporated into teaching and learning. Our team used this as an opportunity to discuss what we could do to deepen the learning and impact.

> Sharing good practice in departmental meetings.

> We have a climate group at my school that meets to share ideas about how different subjects can include these topics in the classroom.

Where the self-taught examples tended to emphasise learning of content, the in-school examples tended to highlight collegial learning as focusing on practice. They also indicate collegial learning, whether in departments, schools or broader contexts, as a potential avenue for working beyond subject silos and supporting the development of interdisciplinary teaching. How this interdisciplinary work is implemented would provide a good subject for further research.

Professional learning activities organised by schools or trusts

A further category of responses were descriptions of more formal activities, or 'professional development' using Pollard et al.'s definition (2023) that were organised in or by schools. These responses tended to describe activities where sustainability and climate change were addressed at a more general, rather than subject-specific, level. Such instances included activities organised by multi-academy trusts[3] (MATs), such as:

> The educational MAT that the college belongs to, had a training day where the issues were presented and the schools in the MAT made commitments to put into place strategies to become more sustainable.

Other examples were described as part of sessions organised for whole school staff:

> A colleague and I organised and led [a professional development activity] for one hour during an in-service training day about a year ago. The focus was on raising staff awareness and encouraging a culture shift to embed sustainability, etc., school-wide.

> My school ran a session on the climate emergency for all staff at the beginning of the school year. I felt that this legitimised me in talking about environmental topics to staff and students on a regular basis.

Such sessions, which broadly address issues of sustainability and climate change, can of course provide valuable awareness-raising, inspiration, and opportunities to develop shared commitments. However, the responses do not make clear the extent to which these activities with a general focus also addressed generic pedagogy and/or subject-specific approaches, both of which are needed to enable teachers to bring them to their classroom practice (Cordingley *et al.* 2015) and to ensure that these crucial topics are not separated from 'core' subject teaching.

Professional learning activities led by external experts

The final category of responses indicated that some teachers in England are (or have been) supported by a wide range of organisations, including international agencies, subject associations, charities and teacher unions. The survey did not set out to comprehensively map this provision; nevertheless, 52 distinct external providers were named by participants (Table 2). The plethora of organisations somewhat correlates with Ben Zvi Assaraf *et al.* (2024) who found that there were 'abundant resources' (p. 14) to support climate change education teaching but that these resources are not always easy to access. How teachers choose the resources, how they use them, and how they evaluate their impact are all subjects that would benefit from further research.

Table 2. External providers of climate and sustainability education-related professional development.

External providers	Mentions
UN climate change teachers/UN:CC Learn	17
Geographical Association	13
EcoSchools	9
National Education Union	7
Carbon Literacy Project	6
British Council	4
EduCCate Global	4
Royal Geographical Society	4
Cambridge University	3
Fresque du climat/climate fresk	2
Learning through landscapes	2
National College	2
STEM Learning	2
Royal Holloway	2
Earthwatch	2
Thoughtbox	2
Forest school	2
Green Schools Project	2
Other organisations mentioned once only	35

The most frequently mentioned provider was UN climate change teachers/UN:CC Learn (hosted by United Nations Institute for Training and Research [UNITAR]). Although UN:CC Learn remains, teachers' comments about the discontinuation of the UN climate change teacher programme highlighted the problem of short-term initiatives:

> I started the UN climate change teacher programme; however, it finished before I finished the course which is a shame as it was fantastic.

> I have started the UN provision for teaching climate change - but ran out of time.

The second most frequently mentioned organisation was the Geographical Association (13 mentions) which, when coupled with the Royal Geographical Society (4 mentions), points to the prominence of geography-focused professional development experiences amongst survey respondents. This finding correlates with the high proportion of geography teachers in the survey; however, it is noteworthy relative to the few other mentions of subjects or subject associations across the 260 responses to this question: science was mentioned 10 times, art twice, and there were single mentions of citizenship and history. The limited reference to subjects could be viewed as indicative of a relative paucity of subject-specific professional development activities that teachers can access to support their climate change and sustainability teaching. Future research could investigate whether external providers are designing their programmes with specific subject teachers in mind, and assuming that they will adapt the material to their lessons, or whether they are targeting school leaders, or individuals with extra-curricular responsibilities.

Priorities for professional learning support identified by teachers

Finally, we report on the types of support that teachers sought. As Figure 2 shows, to incorporate a greater focus on issues related to climate change and sustainability in their

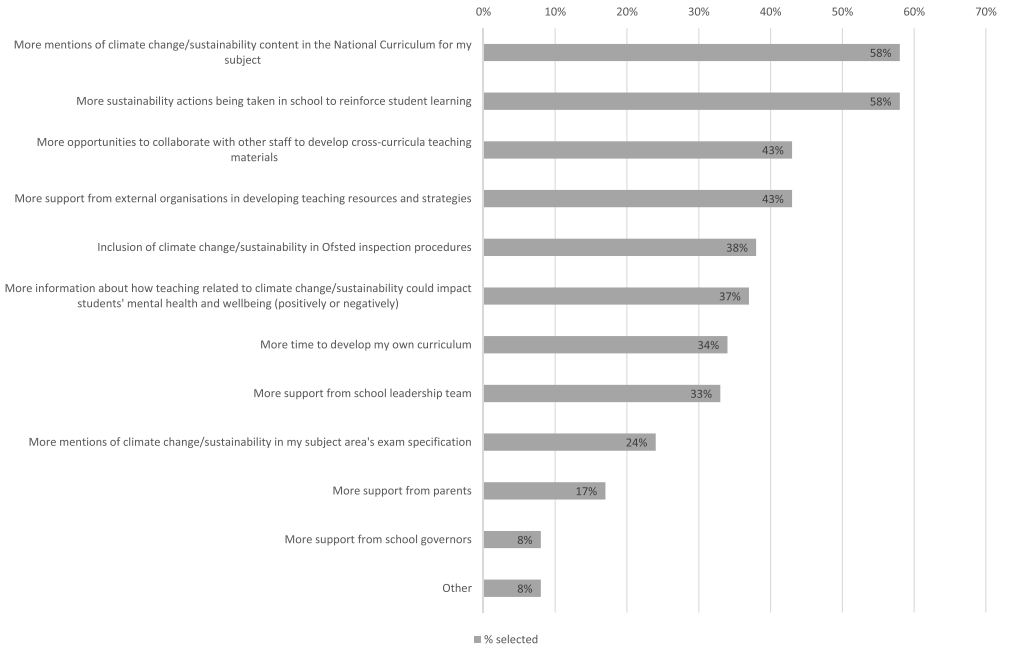

Figure 2. 'Top 5' priorities for support to help enhance teaching related to climate change and sustainability (Greer *et al.* 2023).

teaching, teachers most commonly requested changes to the National Curriculum, which is consistent with the findings reported by the House of Lords Committee (2023) in the review of education for 11- to 16-year-olds, alongside more sustainability actions in schools to reinforce student learning.

On the one hand, the prioritisation of curriculum change could be interpreted as reflecting that teachers want more guidance on what to teach. On the other, given that climate change and sustainability teaching is already occurring in a range of subjects, teachers might perceive that a changed curriculum could legitimise their current practice and/or be a tool they could use to advocate to gatekeepers for the incorporation of additional material. Our previous analysis explored these priorities relative to subject and key stage (Greer *et al.* 2023), and found that teachers at primary level were more likely than their secondary counterparts to prioritise mentions of climate change and sustainability in content in the National Curriculum for their subject, whilst teachers at secondary levels who did *not* teach geography or science, more frequently prioritised changes to the curriculum compared with those who did (p. 32).

Also pertinent for this discussion are teachers' requests for more opportunities to learn with colleagues, be supported by external providers, or to develop their own curriculum; types of support which correspond to a broad conception of professional learning (Pollard *et al.* 2023) and to several features of effective professional learning (Cirkony *et al.* 2024), namely: collaboration, active learning and reflection, content and pedagogy in context, and external expertise. Considering further the types of support that external providers might offer, many respondents indicated that they wanted their

professional learning to take place during school hours, and at their own pace. This preference is, perhaps, not surprising as even the respondents who have engaged in self-taught professional learning might feel that they have given up enough of their own time already. This observation chimes with responses to the question about preferred location for training with 'at my school' being most frequently ranked first preference (59.5%), followed by 'at home' (29.6%), which could be interpreted as reflecting a desire for flexibility, or that teachers think professional learning should happen in school but, if it doesn't, then home is the next best place. Rankings for mode of delivery were: 'in-person' first (44.0%), followed by 'online pre-recorded' (31.9%), and then 'online live' 28.2%). In terms of the type of activity, the most popular amongst the ranked preferences was 'interactive workshop' followed by 'conference-style'. 'Training modules' and 'webinars' were less popular, which is noteworthy given the proliferation of online, asynchronous professional development provision; we explore this incongruence further in our discussion.

In summary, the survey found that a substantial cohort of teachers are teaching themselves how to incorporate climate change and sustainability into their practice, through independent and collegiate practice, and engaging in support from external providers; however, the types of support that respondents to our survey seek – school-hours, at school, self-paced, and interactive workshops – are likely to be difficult to satisfy in the current economic conditions and within the current policy landscape (RQ1). In the following section, we discuss the implications of these results for the provision of professional learning which could help more teachers incorporate climate change and sustainability into their teaching (RQ2).

Discussion

Taken together, the analysis presented in this paper could be interpreted as a good news story about climate change and sustainability-related teaching in England. The results paint a picture of a profession that includes among its members committed individuals who recognise the importance of incorporating these topics into their teaching practice. However, these teachers are working in an education system which has yet to commit fully to its own aspirations of the 'best possible climate education' (DfE 2022) through curriculum and broader policies; for example, through inspection regimes that encourage interdisciplinary curriculum and pedagogy, and which is supported by a system of professional learning. Where major policy shortfalls persist, indeed *because* these shortfalls exist, students depend upon their teachers to incorporate climate change and sustainability into their lessons in meaningful ways that go beyond what is prescribed by the current National Curriculum. Moreover, where these shortfalls extend to the limited provision of professional development activities, society depends on teachers' generating their own related professional learning (Harris and Jones 2017). The ongoing policy shortfalls and the urgency of the crisis means that support which will help this committed cohort of teachers to grow into a professional learning community is urgently needed, and we now explore how this might be possible.

Legitimising current practice: the 'self-taught model' of professional learning in practice and theory

In terms of implications for practice, the prevalence of 'self-taught' professional learning reported in our survey has congruence with the trend towards autonomous online learning and remote professional learning that was accelerated during the COVID-19 pandemic (Cirkony *et al.* 2024), and with trends in professional learning in other fields. For example, a recent study of Hungarian teachers of Languages for Specific Purposes found self-teaching to be the most frequently mentioned type of information professional learning, and a 'significant challenge and difficulty' (Stötzer *et al.* 2025, p. 19). However, despite its widespread practice, self-taught or self-directed professional learning has not merited much attention in the reviews and meta-analyses described earlier. Further conceptual development of this tendency, guided by our research findings, could help to legitimise these practices, thereby helping teachers and those who support them to advocate for resources to enhance its effectiveness.

In terms of developing our theoretical understanding of professional development, we suggest that a 'self-taught model' could be added to Kennedy's spectrum (Kennedy 2014) correlating with a 'transitional' purpose because these activities could be part of an agenda for transmission or transformation (see Figure 3). That is, it can be an approach that teachers are required to use to implement reforms – i.e. 'transmission' - for instance, when new government strategies or policies are released unaccompanied by professional development. Equally, it is an approach that has the potential to be 'transformative', especially if practiced intentionally and collegially. Louws *et al.* (2017) note that the research tradition on self-directed learning can be traced back to theories on adult learning which tend to focus on ideas of personal and professional autonomy (Merriam *et al.* 2007, Knowles *et al.* 2015). They draw on Meirink *et al.* (2007) categorisation which identifies four types of learning activities: 1) learning by experimenting; 2) learning by reflecting on own teaching practice; 3) learning from others (with/without interaction); and 4) learning by doing. As such, in adding 'self-taught' to Kennedy's framework, these categories could be framed as 'characteristics' of the model, thereby creating an approach and a framework that helps teachers to exercise their

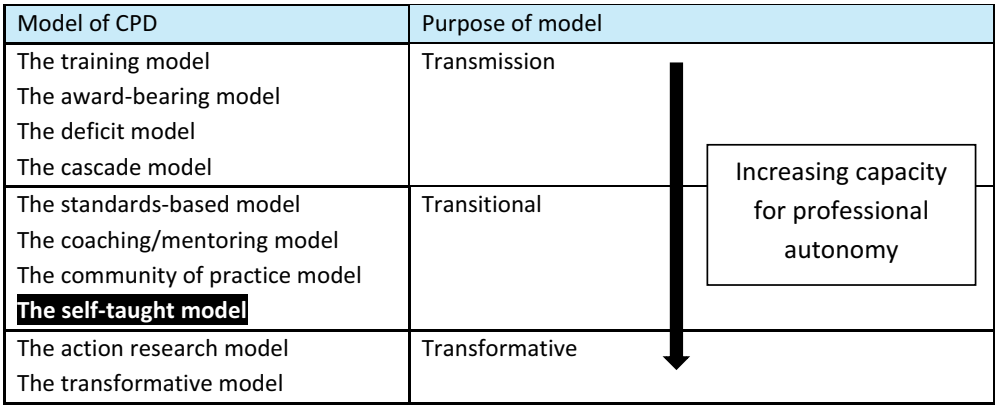

Figure 3. Spectrum of professional learning models, an adaptation of Kennedy's 'spectrum of CPD models' (2014).

professional autonomy and make deliberate and strategic choices about their professional learning; in effect, to professionalise their learning. Consistent with Kennedy's approach, conceptualising this as a 'model' is to acknowledge its prevalence amongst a spectrum of approaches that collectively contribute towards increasing capacity for teachers' professional autonomy.

The affordances of a 'self-taught model' of professional learning can be correlated with features of effective professional learning (Cirkony *et al.* 2024). For instance, it can be readily tailored to local context, be designed as part of teachers' current practice, and embedded within action learning *(active learning and reflection; content and pedagogy in context*). It embodies scope for teachers to make decisions about when and how to participate in professional learning (*audience and alignment*) and be undertaken over a *sustained period*. Its affordances have particular resonance when it comes to supporting teachers to incorporate climate change and sustainability into their teaching: first, because knowledge and practice in this field are evolving quickly, therefore teachers continually have new things to learn; second, because of the shortage of other professional learning opportunities, especially those which are subject (and year level) specific; and, third, because there is a committed cohort of teachers, as we have found, who are willing to put in the time and who could subsequently share their growing expertise with colleagues.

'Self-taught' learning also has inherent challenges. It is 'closely related to intrinsic motivation' (Stötzer *et al.* 2025, p. 21) which is a challenge for issues as pressing as climate change and sustainability: it is unlikely to be taken on by teachers who lack that motivation. Its inherent power relationships also merit critical attention (following Kennedy 2014)) because if this model was to become formalised as the principal approach to teachers' climate change and sustainability professional learning, more powerful agents might let themselves 'off the hook' and divest full responsibility onto teachers. As a model, it will add value to practice if supporting structures are to be put in place, three of which we discuss now.

Strengthening current practice through greater opportunities for collegiate professional learning

Our findings underline the value of collegial approaches to teachers' professional learning, one which is resonant with Cirkony et al.'s (2021) features of *collaboration* and *coaching*. We see the potential for nurturing existing and emerging communities of practice through fora which leverage established or nascent expertise amongst teachers. Communities of practice, as social processes (Lave and Wenger 1991), can stimulate curriculum making within departments or amongst colleagues, support pedagogical development, facilitate reflection, inspire commitment and are means by which professional learning can respond in context-appropriate ways to the variability in teachers' understandings of a topic (e.g. Cordingley *et al.* 2015, Darling-Hammond *et al.* 2017). They can include subject-specific fora, local alliances, or communities that form around schools with more experience, and which can support relative newcomers to a field. Collaborative working involves the development of interpersonal skills that are essential for the collective responses that are inherent to sustainability (Redman *et al.* 2018), and it is compatible with the interdisciplinarity of climate change and sustainability-related teaching. It can support teachers to be imaginative in how they transcend subject boundaries and enact the curriculum holistically, whilst contributing different disciplinary perspectives (Hawkey *et al.* 2019). However, structured support and proper

resourcing are necessary for these forms of learning to be most impactful (Harris and Jones 2017), underpinned by shared values (Redman *et al.* 2018), and a vision and commitment by the school community to sustainability and climate action (Howard-Jones and Hennessy 2025).

Our findings suggest that teachers have limited opportunities for collegial professional learning, and yet those who can leverage these opportunities, both within their school community and through partnerships with external networks, find them valuable. In articulating the Community of Practice Model, Kennedy (2014) citing Wenger (1998), underlines the importance of evolving forms of mutual engagement which support teachers to understand their work and develop their repertoire. Our data underline how providing teachers with opportunities to share ideas and to collaboratively explore and discuss resources are important examples of mutual engagement. Also important was the value and prominence school leaders placed on teachers' professional learning related to these topics which is consistent with research that has explored the role of school leaders in school-based climate change and sustainability education in England (Rushton *et al.* 2025). Therefore, we suggest that policymakers work with teachers' and school leaders' unions and professional associations to identify ways to maximise such opportunities, cognisant of a resource-poor context.

Strengthening current practice through increased engagement with external expertise

External expertise, another feature of Cirkony's list (2024), is important because it brings diverse perspectives, can challenge orthodoxies and it is 'crucial in bringing about substantial improvements to pupil outcomes' (Cordingley *et al.* 2015, p. 6). The troubling lack of professional learning accessed by respondents to our survey means that if England's teachers, including and beyond the engaged cohort represented in our survey, are to build climate change and sustainability into their teaching, a large proportion of schools across the country are likely to require the support of external expertise to do so. Whilst teachers' reported preferences for professional learning in person, in school, and during school hours suggests that localised responses would be most popular, it is unlikely that individual schools, unless they are connected to well-funded, large MATs, will be able to afford to draw on external expertise over sustained periods of time. Therefore, asynchronous resources can be a way of meeting teachers' reported preference for professional learning 'at their own pace', and of providing a wide range of 'expert' inputs at a time and pace of teachers' choosing.

Such resources can be designed to be used in sustained ways, to support context relevant practice, and discussions with colleagues about beliefs and values related to practice (Cirkony *et al.* 2024), the sorts of discussions that might emerge during interactive workshops and conferences (which were preferred modes of professional learning amongst our survey participants). The contributions of external experts can be part of an approach that is alert to the other characteristics of effective professional learning, including that it promotes action-learning in context, collaboration, experimentation and reflection which can be pursued and developed collegially and independently over sustained periods of time (Drewes *et al.* 2018, Pollard *et al.* 2023, Cirkony *et al.* 2024). Of course, asynchronous resources have their limitations; it would not be possible for programme designers to envisage the myriad contexts for practice, but the current curriculum and its subject-orientation seems a sensible place to start. Developing them collaboratively with teachers and drawing on both online and blended

learning approaches could lessen potential disjunction between resources and practice. Consistent with the findings of Jie Li *et al.* (2021), asynchronous resources should include tools to facilitate reflection, support discussion of beliefs and values and enable teachers to confidently experiment as part of their practice. Their effectiveness is also likely to be enhanced by incorporating face-to-face activities and real-time expert and peer feedback (Philipsen *et al.* 2019). Evaluation of how asynchronous resources can support effective climate change and sustainability teaching across the curriculum is a focus of our ongoing research.

Creating enabling conditions through policy change: the England policy context

Finally, it is well known that policy and structural factors constrain the environment that teachers work in, and so systemic changes are necessary to bring professional learning changes about. Within the context of England, the announcement, in July 2024, of a review of Curriculum and Assessment (DfE 2024b) marked a rare inflection point where climate change and environmental care could be embedded across the curriculum in a holistic way, re-setting the baseline of what teachers must teach to include and extend beyond multi-disciplinary knowledge to also incorporate multiple types of knowledge, values and action (e.g. Glackin and Greer 2025; Howard-Jones *et al.* 2021). This is significant when previous analysis of this data has shown that teachers experience the National Curriculum as a key barrier for teaching about climate change and sustainability (Rushton and Walshe 2025). Alongside curriculum and assessment sits school inspection through Ofsted (also undergoing review at the time of writing); this provides opportunities to incentivise schools to support teachers' participation in climate change and sustainability focused professional learning whereby, for example, high-rated schools would be those who make climate change and sustainability-related subject-specific professional learning opportunities available to all teachers, enable interdisciplinary planning and learning, and support engagement with external expertise. A third lever, would be to introduce changes to the professional frameworks for teachers and school leaders, including through the National Professional Qualifications, such that the climate crisis and environmental emergency are visible and responding to them becomes part of the professional responsibilities for all. Through strategic leadership encompassing vision, planning, resource allocation, professional development, and advocacy, school leaders can be empowered to cultivate communities where sustainability and justice are lived values, empowering pupils to navigate the climate crisis as informed, ethical, and engaged citizens (Rushton and Walshe 2025). Examples of such approaches exist, for example, in Scotland, where Learning for Sustainability has been integral to the professional standards for teachers and school leaders for over a decade (Clarke and Mcphie 2016). Finally, this shift would also require a comprehensive, sustained and resourced spectrum of professional learning opportunities which are designed to support teachers, school leaders and the wider school community to respond to climate change and contribute towards sustainability in their community. Here, the refresh of the DfE Sustainability and Climate Change Strategy (also underway at the time of writing) is an important lever for extending commitments to professional learning beyond science teachers, as is the case in the current version (2022). Arguably, a commitment by the DfE which recognises teachers' essential role in developing student capabilities to respond to the climate and environmental emergency would be a powerful trigger for change across all education policies and programmes in England.

Closing remarks

Given that climate and ecological crises present increasingly urgent challenges for Earth and its inhabitants, it is imperative that our education system prepares students appropriately. This research provides timely insights about the state of professional learning that teachers are doing to support their related practice and that, in England, we are fortunate to have a cohort of teachers, some of whom completed our survey, who are willing to invest their time in professional learning which supports their climate change and sustainability teaching. However, children and young people in England are heavily reliant on teachers choosing to make these topics a priority despite, rather than because of, policy requirements. It is clear that maintaining the commitment of those teachers will require ongoing efforts, as will helping them to share their enthusiasm and expertise more widely. Otherwise, and in the ongoing absence of policy directives which fail to address cultural impediments to teachers' related practice (Ben Zvi Assaraf *et al.* 2024) the gap between those schools and teachers who are engaged in these issues, and those who are less so, will endure. Kennedy contends: 'let us be inspired by our young people, and as educators, ensure that we take seriously the impact of our own professional learning in playing a part in working towards climate justice' (2022, p. 3). Policymakers, please take note.

Notes

1. United Kingdom Schools Sustainability Network.
2. National Education Union.
3. In England, multi-academy trusts are not-for-profit companies which run groups of schools and receive funding directly from the government. MATs are inspected by Ofsted but are not required to follow the National Curriculum.

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Appendix

Which subjects do you currently teach?	Not selected	Selected	% Selected
Art and Design	349	159	31%
Citizenship	447	61	12%
Design and Technology	388	120	24%
English/Literacy	350	158	31%
Geography	298	210	41%
History	371	137	27%
Information and Communication Technology (ICT) or computing	404	104	20%
Mathematics/Numeracy	353	155	31%
Modern Foreign Languages	431	77	15%
Music	420	88	17%
Personal, Social, and Health Education (PSHE) (including in tutor and/or form time)	329	179	35%
Physical Education	408	100	20%
Religious Education	386	122	24%
Science	319	189	37%

Subjects that survey respondents currently teach.