

# *Climate change and sustainability education framework: an opportunity for pre-service teaching*

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# Climate change and sustainability education framework: an opportunity for pre-service teaching

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## ABSTRACT

The National Climate Education Action Plan (NCEAP) included 9-actions. Action 2: develop an initial teacher (pre-service) education framework for embedding climate change and sustainability education responding to needing a climate action pedagogy to address the requirements of UK National Policy and Department for Education policy paper 'Sustainability and climate change: a strategy for the education and children's services systems' (Department for Education, 2022).

This paper presents a research project for implementing a framework across three age phases: early years, primary and secondary (2022–23). It explores the development and alignment of teaching to incorporate understanding of climate and sustainability education enabling climate action.

A qualitative approach was employed, drawing on surveys, reflective statements and interviews. Using thematic analysis the reflective statements from 10-teacher educators and a student focus group were analysed along with a student end point survey responses from 79 pre-service teachers. Exploring the extent to which the framework had facilitated the development of pre-service teachers' understanding about how to teach climate change and sustainability education.

The findings suggest that, whilst the sample size was small, there was the potential to embed climate change and sustainability education using a flexible framework, underpinned by thinking related to competencies across different initial teacher education programmes.

Further research is needed to explore how this framework is applied and contextualised, and the impact it has in developing self-efficacy and competencies. An exploration of early adopters as part of a Delphi study or survey might help to contribute to this important area of research.

## ARTICLE HISTORY

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Sustainability; climate change education; competencies; agency; self-efficacy; policy; pre-service teachers

## SUBJECTS


Sustainability Education, Training & Leadership; Teachers & Teacher Education; Theories of Learning; Early Years; Education Policy & Politics; Middle School Education; Primary/Elementary Education; Secondary Education

## 1. Introduction

With issues being faced around the world due to climate change, there is a need to find ways to tackle this in collaborative and jointly responsible ways. Together, we can be empowered to find solutions and make change happen. Whilst there appears to be a great deal of literature pertaining to other related areas of climate change education (Jorgensen et al., 2019) we see a lack of high-quality research into specific climate change and sustainability education related to school settings and pre-service education (Field et al., 2019). This research aims to unpack insights into what might be possible within existing structures and systems through the implementation of the newly designed framework.

This work is being led by a University with a mission to scale up climate education through the setting up of a network of national experts as part of the National Climate Education Action Plan (NCEAP). The action plan was referred to in the Department for Education's Sustainability and Climate Change Strategy (Department for Education, 2022). One of those actions was to develop a pre-service Climate

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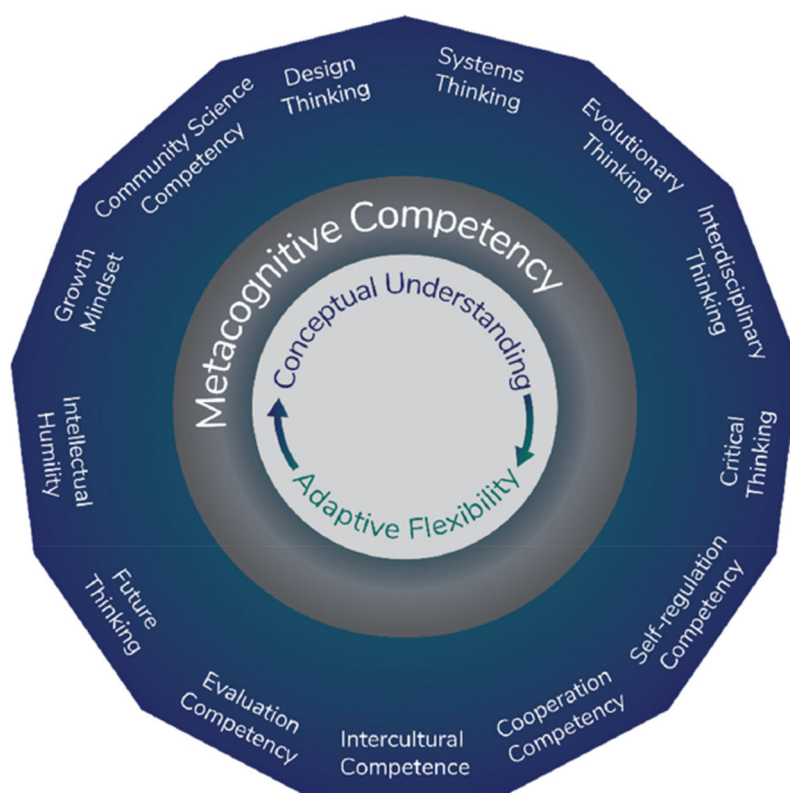
Change and Sustainability Education (CCSE) framework for initial teacher education ([Supplementary Appendix A](#)) (Majid et al., 2022, 2023).

The conceptual and theoretical thinking in this paper exemplifies the need to develop climate change and sustainability education competencies to narrow 'the gap' between knowing about climate action and being able to adopt the values to act. This study includes reflective statements from teacher educators involved in the delivery and adaptation of the CCSE framework; a pre-service teacher focus group; an end-point survey with pre-service teachers. These data sets will exemplify the successes and challenges of adopting such an approach; whilst offering potential insights to others adopting the framework.

## 2. Conceptual and theoretical thinking

### 2.1. Introduction

The conceptual thinking of the Climate Change Sustainability Education (CCSE) framework is underpinned by the need to develop CCSE (metacognitive) competencies ([Figure 1](#)), as outlined by Hanisch and Eirdosh (2023). Scholars such as de Haan (2006) presented competency frameworks in relation to school children; Brundiers et al. (2021); Lozano et al. (2017) and Wiek et al. (2011) presented them in relation to students in higher education. Whilst the work by Sleurs (2008), Strachan (2012), UNECE (2012), Bertschy et al. (2013), Rauch and Steiner (2013), Cebrián and Junyent (2015), and Vare et al. (2022) were all focused on competencies in relation to educators in higher education. But there was no consensus on what a framework for competencies should look like. Hanisch and Eirdosh (2023) highlighted the importance of the integration of the cognitive, behavioral and social-emotional dimensions in developing knowledge, skills values and attitudes, represented in [Figure 1](#) below. Imara and Altinya (2021, p.2) completed a comprehensive overview of competencies in teacher education ([Supplementary Appendix B](#)) over a 10-year period, and noted the key competencies of systems thinking, future thinking, critical thinking, cooperation, normative and evaluative, self-regulation, self-awareness, anticipation, strategic and integrated problem solving (Hanish & Eirdosh, 2023). We sought to apply some of these



**Figure 1.** Developing Metacognitive Competency through the integration of conceptual understanding and the practice of adaptive flexibility (taken from Hanish & Eirdosh, 2023, p.9).



**Figure 2.** The gap – competencies approach in moving between knowledge action and value action (figure created by the authors).

competencies thinking to the CCSE Framework. Sass et al. (2020) refers to these competencies as the flexibility and confidence in own's own ability to influence with a passion to act and this is what we had hoped would be achieved by building others' understanding and ability to do this.

In considering the development of self-efficacy as the behavioural change or action required to move between the knowledge about the action to make change towards the value of taking action, Education for Sustainable Development (ESD) must focus on the cause of that behavioral change and less on changing those values and attitudes (Arbuthnott, 2023). Through conceptual understanding and adaptive flexibility one can work within this area of metacognitive competencies and move between 'the gap' of knowledge action to value action (Figure 2).

The conceptual thinking influenced the theoretical thinking in that there was the need to develop a community of practice (Wenger, 1998) for implementing the CCSE Framework. The core team who had developed the framework were part of that community of practice. The initial teacher education programme directors built their understanding of the CCSE framework, and own metacognitive competencies, through legitimate peripheral participation and socially situated learning.

## 2.2. Pre-service education CCSE framework

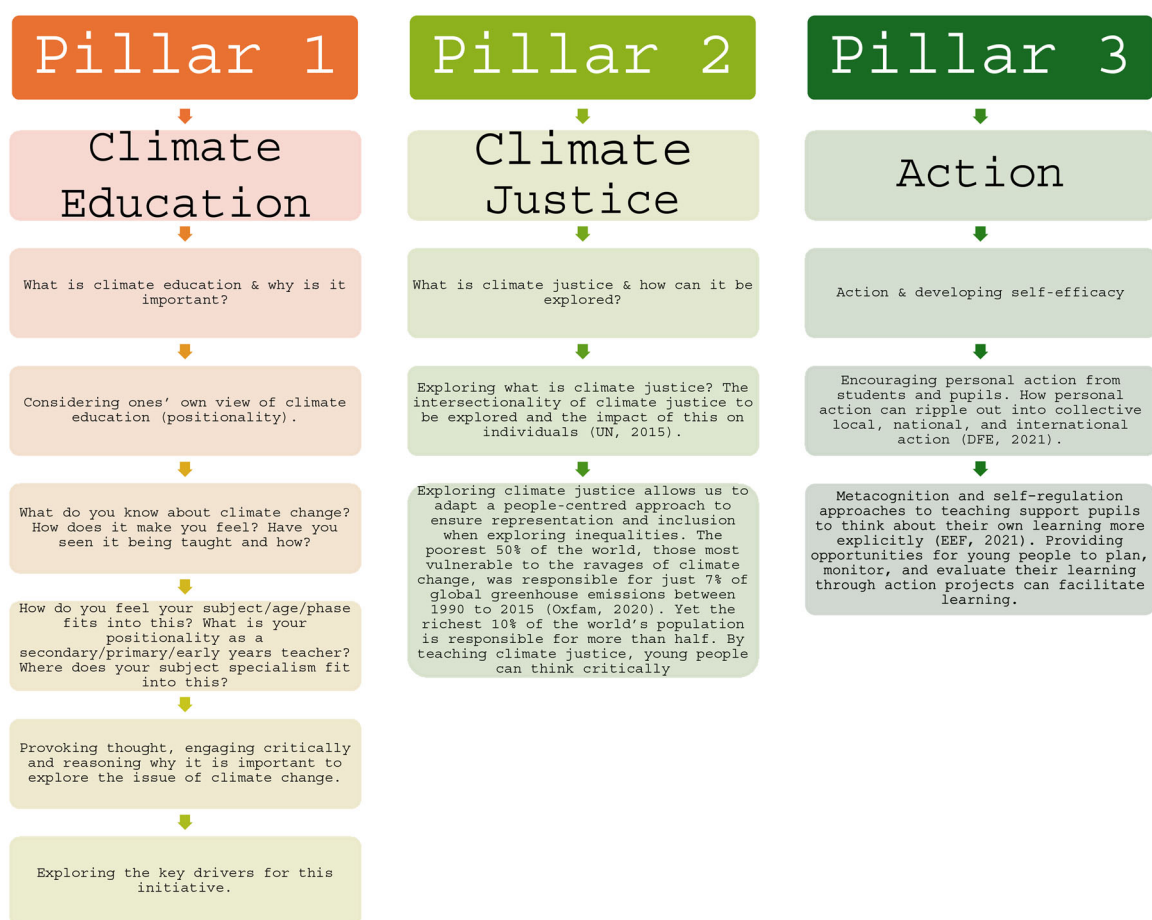
The CCSE framework was designed to focus on three pillars of positionality, climate justice and personal action (Figure 3) because the challenge for educators is often where and how to integrate CCSE (Ho & Seow, 2017). This CCSE framework allows educators and pre-service teachers to reflect on this and provides opportunities for discussion and sharing of ideas about ways to embed it.

Furthermore, it was underpinned with the need to enhance the knowledge, attitudes, values, behaviours and competencies (Figure 4) of pre-service teachers and teacher educators so they become more equipped to teach CCSE in schools and settings.

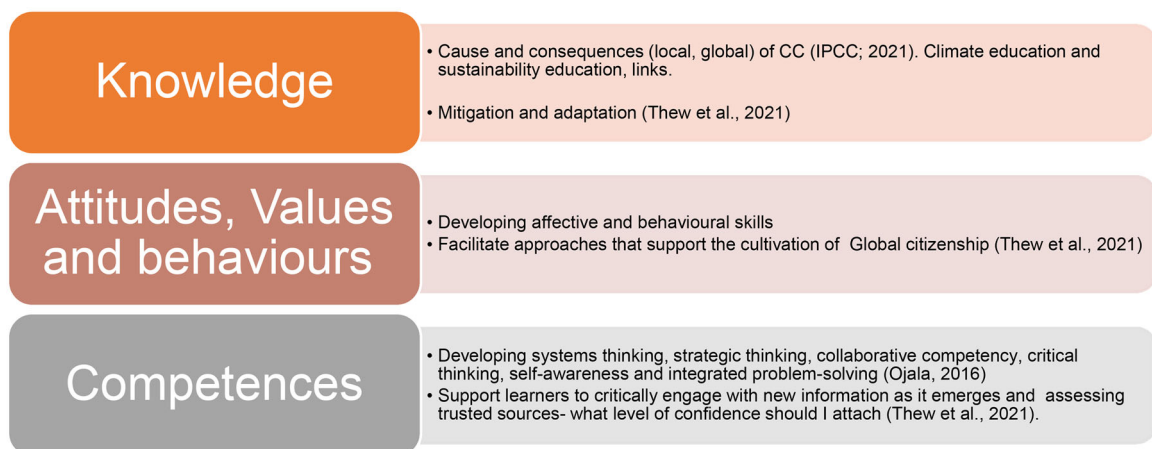
Focusing on improving self-efficacy, the framework's aim is to increase knowledge of climate education and climate action pedagogy and to inspire pre-service teachers to go into their schools and settings with confidence to promote climate action. Sterling (2001) proposed five pedagogical approaches are important for education for sustainability (ESD) and underpin the CCSE framework's ethos: critical reflection, systems thinking and analysis, participatory learning, thinking creatively for future scenarios and collaborative learning. Mula et al. (2022) support Sterling's thinking (Sterling et al., 2017) that a competencies approach can help leverage pedagogical approaches to ESD.

An additional goal of the framework is to reduce eco-anxiety of young people through the modelling to pre-service teachers from teacher educators, of how to react to, and address misconceptions or apprehensions regarding climate. Then, as a result, these observed and learnt behaviors can be cascaded through the pre-service teachers into schools and settings through their own pedagogical practice (Kempster, 2009).

Whilst there is a variety of anecdotal insights into teacher training programmes promoting some aspects of climate change education, what is not clear is the extent to which this is pedagogical content knowledge. Winter et al. (2022) found that educational institutions are not sufficiently preparing pre-service teachers to teach this topic and argues for a curricula focus which centres on community, benefiting both schools and training teachers, promoting a more consistent approach.



**Figure 3.** The three pillars: ITE framework CCSE (Adapted from Majid et al., 2022).



**Figure 4.** Underpinning aims & objectives to develop through the pre-service teaching CCSE Framework (adapted from Majid et al., 2022, Majid et al., 2023 and Reed Johnson, 2023).

The CCSE framework purposefully sought to develop a pedagogically focused approach, as it was revealed by Boyes and Stanisstreet (2012), that an increase in knowledge does not necessarily lead to behavioural change, which is the core purpose of this framework. This 'knowledge-behaviour' gap (Wibeck, 2014 and Arbuthnott, 2023) is referred to in Figure 2 above.

It is affective responses that drive climate change related behaviours (Brosch, 2021) and these tend to be encircled by more holistic, comprehensive and transdisciplinary approaches (Long & Henderson, 2023). Indeed, Field et al. (2019) advocate courses to be continually modified as a collective



understanding of CCSE evolves. This helps create a transformative approach centring on climate justice, agency and collective action (Kwauk & Case, 2022), exactly what the CCSE framework was designed to achieve.

### 3. Literature review

#### 3.1. Introduction

Climate change education is still a developing area in terms of what it constitutes (A. Reid, 2019). We can see this from the views raised by various scholars, such as Asshoff et al. (2021) noting that research in this area has focused on knowledge and understanding of climate literacy. Field et al. (2019) suggest that the lack of climate change research in the field of pre-service teaching may be due to the fact there is a lack of training in this area more generally. Busch et al. (2019) highlight the idea that when a person's understanding and acceptance of climate change is happening, only then are they able to act. Bangay and Blum (2010) previously said that mitigation strategies were often neglected in education. This resonates with the ideas raised by Winter et al. (2022), discussed earlier. The review of pre-service teaching around climate education by Cebesoy (2019) found that training teachers were either unprepared to teach this important topic, or that they were conveying misconceptions (Cebesoy, 2019) due to lack of confidence or knowledge. Often, provision of CCSE training may be related to developing environmental awareness through short-term outdoor environmental programmes which may be ineffective in developing increased teachers' environmental awareness and sensitivity to the natural environment (Okur-Berberoglu et al., 2015).

Foran et al. (2018) stated that for university educators there is a sense of urgency that is driving the integration of climate change teaching, which can lead to higher levels of climate anxiety in students (Galway & Field, 2023). Demant-Poort and Berger (2021) conducted a research survey in Canada and Greenland with education students and identified a need for more knowledge-based causes of climate change. This is contradictory to the findings of Winter et al. (2022) who argue for stronger pedagogical approaches. Boon (2010) also suggested that climate change education in pre-service teaching often leads to misconceptions, particularly in relation to the distinctions between climate and weather. Anderson (2012) previously noted the need for more learning in the situated community context to stimulate action orientated and participatory learning (Mallon, 2015). This is reinforced by Berger et al. (2015) who championed action and hopeful approaches to stimulating student imagination in relation to collective action.

Indeed, the development of competencies is interlinked with the values, behaviours and attitudes that people have as well as one's own positionality, which individuals are encouraged to explore through the CCSE framework. In a study by Mula et al. (2022), it is suggested that there is a need to move from teacher-centred learning towards student-centred learning to develop values, attitudes and behaviours through a competencies approach. ESD competencies noted by the Advanced Higher Education Academy (2021) include systems-thinking, future-thinking, problem-solving and collaboration. This type of collaboration or collective action is essential in empowering young people to make change particularly when there are [apparently] increasing levels of climate anxiety (Hickman et al., 2021). By helping young people to engage in localised issues, it is possible to help them collaborate with their community to integrate action elements which have impact (Ardoin et al., 2020; Hoath & Dave, 2022), thus helping to reduce a young person's climate anxiety.

#### 3.2. Metacognitive competencies

Hanisch and Eirdosh (2023) describe metacognition education as the cognitive process of making sense of knowledge and then planning, monitoring, and regulating. This would allow educators to engage learners with both science and the effects of climate change, whilst tapping into the cognitive tools of problem solving, critical thinking and decision making (Vare et al., 2022).

Although climate change is discussed widely in social and mainstream media, attitudes are often polarised (Falkenberg et al., 2022). Thus, the use of metacognitive approaches, known to increase



students' ability to adapt their learning to novel tasks and contexts are beneficial (Palinscar & Brown, 1984). Sterling et al. (2017) said: '*sustainability competencies can be a starting point to leverage pedagogical transformation and stimulate fundamental systemic changes in educational organisations*' (as cited in Mula et al., 2022 p.185).

It is these metacognitive competencies that integrate the conceptual understanding of how humans behave along with practicing adaptive flexibility in responding to everyday experiences. It is through structured metacognitive practice that a student's level of resilience thinking is improved (Spellman et al., 2016) and through problem-focused and meaning-focused strategies, pro-environmental behaviour can be enabled (Ojala & Bengtsson, 2018).

Luo and Zhao (2021) suggested that by engaging students in discussions about global warming where they are exposed to opposing views, then educators can incorporate communication tools to foster these metacognitive processes. Techniques such as considering one's own and others' positionality; reflecting and discussing both aspects, is also a similar way for developing these communication tools.

### 3.3. Self-efficacy

Enabling ESD competencies encourages greater self-efficacy. Self-efficacy, as a dimension lends itself to categories (or themes), taken from Bandura (1977, 1986, 2000), such as agency, mastery, modelling, problem solving, self-belief/confidence, motivation and these will initially be defined in [Supplementary appendix C](#). These different dimensions of self-efficacy need to be developed through the underpinning competencies in responding to climate change or other sustainability issues (AHE, 2021; UNECE, 2012; UNESCO, 2020).

Bandura (1995) defined self-efficacy as being developed from four major forms of influence: mastery experiences, vicarious experiences, social persuasions, and physiological and emotional states (Chichekian & Shore, 2016). It affects how one approaches goals, tasks, and challenges based on a person's own self-belief. Hence the need for the framework to help pre-service teachers to reflect on their own positionality, values, and beliefs in framing their initial self-efficacy and confidence in delivery on climate education. Agency is a category of self-efficacy and described as the ability to act, as described in [Supplementary appendix B](#). That action is possible through the development of competencies.

Self-efficacy significantly influences the ability that a person holds to face challenges in a competent manner through the choices that they will make. This effect is particularly apparent about behaviours that impact on the investment an individual may have when dealing with tricky or complex subjects e.g. climate change. Indeed, in a systematic review of 82 studies of teachers' self-efficacy, it has been suggested that teacher self-efficacy influences both the motivation and interest of their students (Morris et al., 2017).

Motivation depends on having both knowledge and a sense of agency (Deci et al., 1991). By participating in learning about climate change and how to act one can develop a sense of hope. One is motivated to act, as has seen possibilities within their own social situation. This is how students can be encouraged to understand and be motivated by exploring the global issues of climate change and the impact it has both globally and locally. The literature focused on this development of agency is limited but Hansen et al. (2021) found that there were some studies that look at the agency in relation to climate change in university students. This is where Winter et al. (2022) suggested that educational institutions should be equipping both educators and students to be able to become change agents and then to pass this learning on to the people they then go on and educator. In this way, we create a multiplier effect in which teachers in the schools have the motivation, self-confidence and agency to become role models when they themselves take personal action in relation to climate change (Schelly et al., 2012).

Self-esteem relates to what one thinks of oneself. High self-esteem means one has a high regard for oneself. Self-confidence purports to how one believes one can achieve something. Bandura (1989) and Schunk argued for the need to study peoples' self-perceptions in different settings to see how they respond and cope (Chichekian & Shore, 2016). If we relate this to teaching about climate change, then teachers might think they have sufficient knowledge and understanding to do this as they studied Geography at school. However, they may not be able to relate this understanding to the ideas behind

social justice. So whilst they have a high self-concept of climate, they may not have high self-confidence to teach it.

For the purpose of this study and the framework, the focus has been the emancipatory perspectives of ESD which focus on critical thinking, collaboration, developing self-awareness and problem solving that can all be listed as competencies (Figure 1). Pre-service teacher education should not just be about transmitting knowledge related to climate education and sustainability but needs to encourage and further develop critical thinking, inter and trans-disciplinarity approaches and collaboration (SDSN, 2020; UNECE, 2011).

## 4. Research design

### 4.1. Context

The CCSE framework development (initial development phase November 2021–May 2022) was led by an educational institute in HE and implemented for this research between September 2022 to June 2023. The institute is highly regarded for Education in the UK (The Guardian University Guide, 2024). It offers a range of educational programmes, including Undergraduate and Postgraduate Teacher Training courses leading to recommendation of Qualified Teacher and Early Years Teacher status (DfE), working with over 400 partnership schools and settings through the phases of Early Years, Primary and Secondary and a multi-disciplinary approach. [Supplementary Appendix C](#) shows the spread of programmes, phases and subject specialisms involved in this study, as well as those from other providers. The draft framework was introduced to programme directors, who formed the community of practice. During that process the core team who had developed the initial framework gained feedback and in May/June 2022 the core team members liaised further with programme directors and their teams, to help them consider how each programme would use it in a contextually relevant way. It was through this process of legitimate peripheral participation that they were able to build their own understanding whilst also embedding it across their programmes.

The use of the CCSE framework was designed to facilitate communication about ideas for embedding climate and sustainability education across pre-service programmes. The research adopted a qualitative research approach. The data collection tools: survey, focus group, reflective statements, were designed to understand the teacher educators' experiences of adapting the framework; whilst also understanding the impact on pre-service teachers (see [Supplementary Appendix D](#)).

#### 4.1.1. Research questions:

1. To what extent do the pre-service teachers (students) feel that the CCSE framework has allowed them to develop their understanding, competencies and confidence in delivering CCSE?
2. What are the perceptions and reflections of teacher educators in relation to developing the knowledge, values, behaviours, attitudes, competencies and confidence of pre-service teachers (students), and to what extent can it facilitate the advancing of their thinking in delivering CCSE in their school settings?
3. How does the development of knowledge, values, behaviors, attitudes, competencies and confidence relate to the development of self-efficacy?

This study brings to the surface the extent to which pre-service teachers may be prepared to develop understanding about climate change and action in pupils in their teaching, through the perspectives of pre-service teachers and teacher educators engaged in this training through this study (2022-23).

### 4.2. Data collection tools

A mix of data collection tools were employed to gather data from both pre-service teachers involved in the study and the teacher educators who taught the sessions. [Supplementary Appendix E](#) sets out the phases of the data collection and the tools used to collect data sets across one academic year:

Programme Directors were guided in adapting the framework to suit their existing programmes. A schedule for each programme was developed, with teacher educator training sessions, resources for

taught sessions being shared between teacher educators, and guest speakers provided to ensure the teacher educator could build their own confidence in delivering programmes on CCSE. The sample of participants and pseudonyms used are shown in [Supplementary appendix E](#)

### **4.3. Data analysis**

The data collated for this study was analysed using descriptive statistics and thematic analysis. Qualitative thematic analysis (Braun & Clarke, 2006) was employed as the process for analysing the data from the comments from both the Phase 1 and 3 surveys, the reflective statements from teacher educators (Phase 2A), the comments from the focus group with pre-service teachers (Phase 2B) and the survey reflections from teacher educators (Phase 3). This analysis method was selected to make sense of this rich data in relation to the key areas of interest; agency and self-efficacy (of which agency is an aspect of). A deductive method of thematic analysis required considering the pre-determined categories. These emerged from the definitions of self-efficacy described in the literature review. The dimension of self-efficacy ([Supplementary appendix B](#)) then allowed categories and descriptors to be identified which were assigned to the competencies ([Supplementary appendix F & G](#)). These competencies were drawn from the metacognitive competencies. As part of this process the research team familiarised themselves with the data and coded it. The quantitative data from the end point survey of pre-service teachers (Phase 3) were analysed through descriptive statistics and presented as bar charts. This process was used to demonstrate trends and patterns that had been achieved by the end of the pilot phase, which was a small-scale study.

### **4.4. Ethical consideration**

BERA guidance informed the ethical approval processed through the University ethics committee. Ethical approval was gained prior to the start of this study. [Supplementary Appendix D](#) highlights the phases of the data collection. All pre-service teachers and teacher educators were presented with a project information sheet and consent form. This detailed the ethical process, their role in the project, and their rights to withdraw. Academics delivering the framework were asked to complete their reflective statements on a form after they had taught their sessions. The survey, online, included a consent statement that was completed via a tick box before the questions could be answered. Again, consent was sought and provided by all participants.

## **5. Results**

### **5.1. Introduction**

This section presents the findings of the extent to which the pre-service teachers (students) felt that the CCSE framework had allowed them to develop their understanding, competencies and confidence in delivering CCSE (Question 1, [Section 5.2](#)). Then, presents the pre-service teacher perspectives of how they have advanced their thinking through the work done in applying the framework (Question 2, [Section 5.3](#)). We explored this through the teacher-educator reflective statements. The study then looks at the lens of self-efficacy and how it links to the development of confidence and competencies (Question 3, [Section 5.4](#)).

[Table 1](#) illustrates the taxonomy of categories of self-efficacy emerging from the deductive analysis from reflective statements, surveys and focus groups and used in exploring each research question.

### **5.2. To what extent do the pre-service teachers (students) feel that the CCSE framework has allowed them to develop their understanding, competencies and confidence in delivering CCSE?**

The data illuminates the extent to which this framework enabled pre-service teachers to develop their understanding, competencies and confidence are shared below.

**Table 1.** Taxonomy of categories of self-efficacy emerging from deductive analysis from reflective statements, focus group and survey.

Category	Relates to competencies	Description (adapted from Supplementary appendix C)	Example quote
Agency	Design thinking. Evolutionary thinking Critical thinking	Student agency and learning have a circular relationship. They play an active role in deciding what and how they will learn, demonstrating motivation. Development of agency is relational.	TE1: 'Students were presented with resources which could spread misconceptions and discussions about why this might be were detailed.' TE4: 'A discussion about 'tricky questions' that may arise from children were considered, alongside misconceptions that children (and adults) may have and how they could be addressed.' Pre-survey: Student A: 'I would love to do something about it in school. I definitely think giving teachers/schools the education and resources is so important for us to be successful.' Focus Group: In charge of own project, really engaged, making own decisions (talking about pupils in school)
Mastery	Evaluation Interdisciplinary thinking Systems thinking Future thinking Cooperational Growth mindset	Mastery builds confidence in students and thus creates a desire to build on current skills and thus acquire new knowledge	TE2: 'Delivering the framework has deepened my knowledge in the intersectionality between climate and social justice and in terms of sources of information on the impact of climate change on the global south.' TE3: 'We touched on some broader socio-economic issues and concepts such as political ideology, capitalism, developing vs developed economies, and issues of poverty and deprivation, all within the context of analysing the limitations individuals, societies, and countries can face in taking affirmative action against climate change.' TE6: 'Encouraging students to work cross subjects, in order to appreciate the knowledge and skills from other disciplines.' Pre-survey: Student D: 'I think it is incredibly important to make children aware of what is happening in the world and how they can start to make changes to improve this situation.' Focus Group: Practical input, prior knowledge, prior training and experience, constructivist teaching model, collaboration

*(continued)*

Table 1. Continued.

Category	Relates to competencies	Description (adapted from Supplementary appendix C)	Example quote
Modelling (doing)	Systems thinking Intellectual humanity Design thinking. Evolutionary thinking	Modelling as an approach to teaching and learning may affect elevated levels of self-efficacy and agency in learners because the threat level of understanding complex and confusing information is reduced,	TE6: 'Art/artefacts/sculptures were produced to make a statement relating to plastic pollution and the impact on the countryside in the UK.' TE7: 'The students are now aware of the problems faced by British farmers and those teaching Food in schools will certainly be building this new knowledge into their teaching.' Pre-survey: Student E: 'Some subjects lend themselves more to the content of climate education, but it can and should be incorporated into all subjects.' Focus Group: Vicarious experience, reusing waste to make new practical products, linking to real life, student demonstrator models of work,
Problem-solving	Evaluation Future thinking Systems thinking Interdisciplinary thinking Design thinking Cooperation	Problem-solving/problem-based learning creates opportunities for learners to develop their agency by making sense of a problem at the edge of their learning.	TE5: 'Cross curricular awareness of how different disciplines can work together to build a deeper understanding of an issue – in this CCSE, using recycled materials to create art inspired by British native plants/insects.' TE6: '... a deeper understanding of each other's concerns and beliefs regarding sustainability and climate change.' TE3: 'The key thinking developed by students, centres on conceptualising climate change and sustainability at the micro-meso and macro levels. Specifically, reflecting critically on individual, systemic and socioeconomic geopolitical (capitalism, developing countries) roles and responsibilities in taking action.' Pre-survey: Student G: 'All subject areas can include subject material on CCSE to slightly different degrees, and all classrooms can be places where actionable plans for better sustainability can be taught and discussed.' Focus Group: Challenges, dealing with complexity, solving problems, noted a big part of Design and Technology, strategic thinking, long term problems,

(continued)

**Table 1.** Continued.

Category	Relates to competencies	Description (adapted from Supplementary appendix C)	Example quote
Self-belief/ confidence	Self-regulation Evaluation Intercultural	Students have the ability to complete tasks and achieve their goals	TE1: 'Many students commented that they felt empowered to go and take this topic into school and teach it confidently in the future.' TE4: 'A range of ideas were shared with the students about how they could take small steps to empower children to partake in activities that can reduce global emissions.' TE3: 'The session challenged students to consider their own views, beliefs and thoughts on climate change before examining the importance of providing a balanced view as an educator and managing the dynamic between personal and professional.' Pre-survey: Student I: 'We need to develop the understanding of future generations to protect our planet and make informed choices in their habits.' Focus Group: Our opinions and beliefs we have about ourselves. Our overall sense of worth and emotional states. Positionality.
Motivation	Growth mindset Intellectual humanity Self-regulation Cooperation	Motivation closely aligned to agency and confidence.	TE1: 'Many students had already made personal changes to their day to day lives with sustainability in mind. This provided an excellent base for knowledge development, which students were keen to put into action in the classroom.' Pre-survey: Student K: 'I want to know more and how to teach this effectively to encourage pupils to consider their place in this.' Student L: 'As a trainee and committed nature lover, it is very important to address the climate changing issues wherever we can.' Focus Group: Practical input, project ideas, personal importance, teacher educator enjoyment, making it real life, doing in and outside school.

### 5.2.1. Initial survey

Phase 1 of the data provided by 71 pre-service teachers from three different universities as outlined in Table 1 (contextual information) has been discussed in a previous paper and showed that 84% of the participants felt that they would like to be taught how to teach CCSE in schools (Majid et al., 2023), yet their knowledge of government policy in this area (DfE, 2022) was scarce. Opinions on where CCSE should be taught were mixed, with most respondents citing geography and science although interestingly, all subjects were also mentioned. The topic of eco-anxiety was also prominent, as evidenced through the quote below from the Phase 1 data:

*'Climate change is an important issue and can be very, very daunting and cause anxiety. Therefore, it is important to have children become knowledgeable about how they can help'* (Majid et al., 2023)

The respondents in this first survey indicated that most of their knowledge on CCSE stemmed from their own research, yet they reported that they would like specific training on topics such as global warming, energy, social responsibility, for example. Consequently, phase 1 of the evaluation provided evidence of the will for pre-service teachers to be taught this information on their training courses and added a deeper rationale for the need of the framework.

The following quotes give an indication of the mixed responses received:

*'Not much Geography relevance from what I can remember from GCSE'*

*'It was not a big part of the modules I learned at GCSE, so most of my knowledge on the subject was self-taught.'*

*'During my time at secondary school I don't remember studying climate change either in science and geography and I dropped geography at key stage 4. However, based on my previous school experience teaching climate change and the 5218\* module I feel slightly more prepared as I have subject knowledge and pedagogical strategy I could use to teach it.'*

Some of the key positive findings were that 72% of respondents indicated that there does need to be a comprehensive programme on CCSE and felt that climate education should be prioritised (62% of respondents); whilst 75% of respondents believed it was also important to explore climate justice. 70% of respondents indicated that every teacher should be involved in teaching climate and sustainability education and across all subjects (68%) and that it should be prioritised in schools (66%) where the training should be for both existing and training teachers (79%). There was an overwhelming belief (84% of respondents) that there is a need for leadership and a whole school approach. The reasons behind some of these responses were that respondents (74%) felt it was important for helping young people to make decisions in their lives; and for promoting self-efficacy and critical thinking (84% respondents). However, only 57% agreed or strongly agreed that this training should be part of their pre-service teacher education programme, whilst 32% remained neutral.

### 5.2.2. End point survey

79 pre-service teachers from the three participating universities completed an end-point survey (Phase 3) in addition to the initial survey (Phase 1) which aimed at exploring their perceptions of the teaching of CCSE. The survey was completed by a mix of pre-service teachers from different phases and subjects; but the majority of responses were from primary PGCE trainees (70%) with 20% responses from PGCE Secondary trainees. Where trainees had studied geography or the sciences at key stage 3, 4 or 5 there were mixed views in terms of how this had prepared them for teaching CCSE.

73% who responded felt they had been supported to teach this through their university input whilst 27% responded neutrally, disagree or strongly disagree. In terms of how pre-service teachers felt supported through their school placements only 56% indicated that they had been supported through their placements with the remaining 44% indicating neutral or disagreeing. 90% of respondents indicated that they had engaged in university sessions.

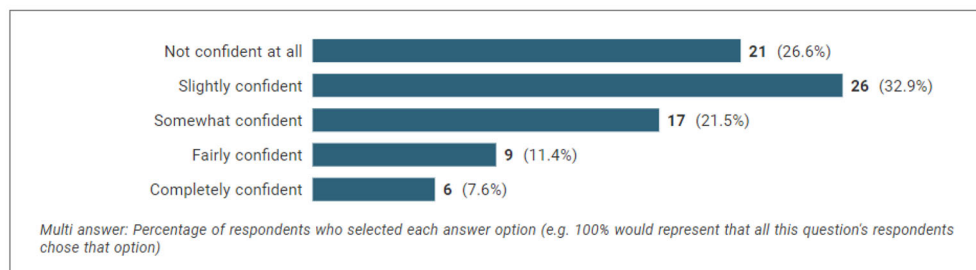
Pre-service teachers shared that these aspects of their training were the most beneficial to them:

- develop knowledge about what climate change is (76%).
- understanding the consequences of climate change both locally and globally (73%).
- Climate education was a useful way of discussing values and ethics in relation to social justice (76%)
- understand how climate change links to sustainability (67%).
- learning about the SDGs (63%).
- understanding how to get learners to act and work with others in solving problems around climate change and sustainability (65%).
- considering behavioral change and the impact on action (65%).
- follow on tasks in schools (49%).

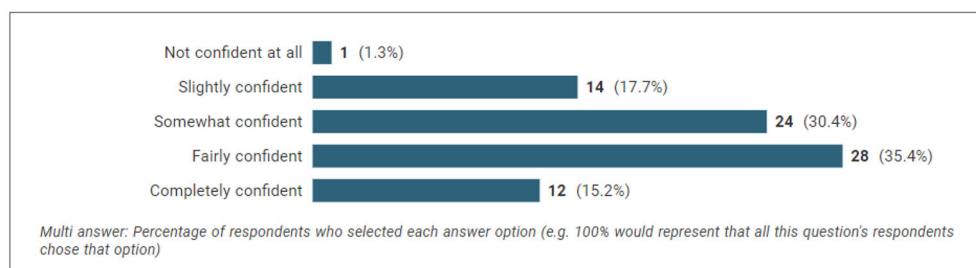


**7** Indicate below your confidence to teach climate and sustainability education

**7.1** At the start of this academic year



**7.2** At this point in the academic year (end)



**Figure 5.** Confidence to teach climate and sustainability education at the start of the year and at the end point of the pilot.

The above data provides an indication that there had been a development of understanding and knowledge of CCSE and that the pre-service teachers now had some ability to engage learners through problem-solving, thus developing competencies as well as building confidence through the follow-on school tasks and shown below in Figure 5. 65% of respondents believed that there had been behavior changes and impact on actions.

All the other responses were below 50/79. Those that were significantly lower were: competencies and capabilities (29%) and attitudes, values and skills (37%). But it is not clear as to why that might be and whether respondents had understood the questions. Only 21% of respondents had made use of the Sustainable Development Goals (SDGs) in their teaching and there was an overwhelming view that the follow up tasks to do in schools were the most important aspects in developing their understanding 49% with 30% neutral.

Figure 5 shows the responses indicated a shift in confidence of the pre-service trainees from the start of the academic year to the end-point survey. At the start there was a negative skew with 27% indicating no confidence and 54% with only some slight confidence. By the end of the pilot this had shifted to 1% of responses indicating no confidence and 48% still only slight confidence, although those that had indicated confidence at the start (19%) had increased to 51%.

### 5.2.3. Focus group

10 Pre-service teachers indicated on the survey form that they would be willing to take part in the focus group. [Supplementary Appendix G](#) shows the descriptor codes generated from the data collected using the pre-determined themes that were matched to the data from the focus group.

The data from the focus group demonstrated that the modelling of potential activities that could be taken into schools was the most beneficial experience and emphasised the 'practical input... project ideas' on numerous occasions. It must be noted that this was a design technology trainee teachers' response, so a much more practical subject. This trainee also indicated that the climate and sustainability work fitted in well with design and technology teaching. The focus group participants had developed good self-esteem and self-confidence with opportunity to draw on prior knowledge.

The importance of the pedagogical approach in this CCSE framework being underpinned by metacognitive competencies is that it allows the learners to not only consider the knowledge about climate

change and sustainability but also consider the challenges of climate change, and to have the cognitive tools to think critically in considering these dilemmas, being able to come up with informed decisions on approaches to take that impact on them locally (Monroe et al., 2019; Vare et al., 2022). Thus, creating an open-minded state through deeper learning (Lou & Zhao, 2021).

For example, the focus group described developing a sense of mastery of experience that allowed them to go into school and embed this into their own teaching. They were motivated and interested, they wanted to help the pupils in their lesson to *'solve problems' 'using a constructivist teaching model'* and making the experience as real as possible by using:

*'real world problems'*

*'... that they felt related to those real-world problems'*

And by providing:

*'student demonstrators ... to show and share with other students, and I found that was really powerful when they were listening to each other'*

A pre-service teacher indicated that the pupils:

*'really engaged well with the idea that they were in control of their own project and had that agency over it'*

The findings support the need that CCSE should be delivered through teacher education programmes which supports the ideas of Field et al. (2019). Pre-service teachers indicated they wanted this learning to not only focus on knowledge, advocated by Niebert (2019), but to be across all subjects, interdisciplinary (Winter et al, 2022), adopting whole school approaches. The area of social justice was highlighted by pre-service teachers as a particularly beneficial area of learning, along with enabling learners to act and for them to consider behavioural changes.

The most significant indicator of the development of self-efficacy in pre-services teachers was through the change in confidence to be able to go into schools and teach this (Figure 5) shown at the start and end of the pilot year.

What was revealed from the focus group (Table 1) is that the pre-service teachers had been able to help pupils in school build on prior knowledge in thinking about ideas on climate education. They were then able to build on this through a constructivist teaching model, demonstrating mastery, evaluation, growth mindset. In this project, they had seen how important it was for the pupils to develop their own ideas, demonstrating agency, design thinking and critical thinking. Modelling was also important through building in vicarious experience in reusing waste and making new products. The pupils in schools were able to link these ideas to real life. Here we see the development of understanding around systems thinking, intellectual humanity. From a problem-solving perspective, pre-service teachers provided pupils in school with opportunities to deal with complexity and solve problems; demonstrating systems thinking and interdisciplinary thinking. These pre-service teachers were able to see how pupils were building their confidence through their developed understanding, and demonstrating self-regulation, cooperation and evaluation.

The key insights from the pre-service teacher focus group were around modelling, mastery and problem solving. Problem solving is one of the metacognitive competencies and what we see evidence of here is that the teacher educator was modelling what was possible for teaching in schools to the pre-service teachers, an approach advocated by Field et al. (2019).

The focus group also identified how the teacher educators had worked in interdisciplinary ways; highlighted by the teacher educator reflections. Thus, the ability for mastery of experience from differing perspectives was possible and, in this example, bringing together science, art and design technology students, an approach supported by Anderson et al. (2012).

### ***5.3 What are the perceptions and reflections of teacher educators in relation to developing the knowledge, values, behaviours, attitudes, competencies and confidence of pre-service teachers, and to what extent can it facilitate the advancing of their thinking in delivering CCSE in their school settings?***

The evidence presented illuminates the reflections of teacher educators in relation to their pre-service teachers being able to develop their understanding, competencies and confidence due to the delivery

of the CCSE framework as well as the extent to which it has facilitated the advancing of their thinking in delivering CCSE. This is drawn from interviews with teacher educators whose profile and pseudonyms are presented in [Supplementary appendix E](#). They were asked to reflect on aspects of their teaching after delivering a session based on the framework.

The dimensions of self-efficacy were used as an exploratory lens, to help understand the extent to which the CCSE framework is able to engage learners to take action. Whilst this research has not looked at learners in schools' development of self-efficacy, what it has done is explore the dimensions of self-efficacy of pre-service teachers and their ability to take action by embedding this into their teaching in schools. Hence, providing training teachers with the emancipatory aspects of ESD and ensuring they are not just the transmitters of knowledge about climate change. In this way, pre-service teachers can become multipliers for climate action and have the ability to be role models to demonstrate actions to mitigate climate change (Schelly et al., 2012).

### **5.3.1 Agency**

Our findings have shown that the teacher educators found the CCSE framework to be empowering. Through the development of agency, they have developed the confidence and competence of pre-service teachers in relation to their teaching of CCSE. The teacher educators emphasised how the pre-service teachers had been able to reflect on their experience in the university sessions and take it into their teaching in school through a process of reflection. They presented them with materials and 'tricky questions' that might lead to the pre-service teachers generating misconceptions in their own teaching and that by discussing this they were able to identify ways around this thus developing their confidence for teaching it ([Table 1](#)). Thus, the development of design thinking, evolutionary and critical thinking.

### **5.3.2 Mastery**

The teacher educators emphasised the ways in which the pre-service teachers critically engaged with new materials and the host of sessions that were provided to stimulate thinking through the mastery of others. For example, focus days in working with wider organisations such as the Museum of English Rural Life (MERL) and working in interdisciplinary ways across subject specialisms in secondary training. Also, development of understanding of climate and social just through working with Reading International Solidarity Centre (RISC) that also deepened the knowledge of the teacher educators. Thus, through a mastery approach being able to cultivate integrated knowledge, whilst dealing with the more complicated political and socio-economic aspects of sustainability ([Table 1](#)). Highlighting the importance of self-efficacy, systems thinking, interdisciplinary working and evaluation.

### **5.3.3 Modelling**

The teacher educators took the approach of modelling. They were able to demonstrate how small actions can make a difference and how they might follow this up whilst on their school placements. How they could emphasise the roles of individuals as citizens and how that might look in practice. So, reflecting on intellectual humanity through the review of different approaches to teaching such as artefacts and issues for British Farmers ([Table 1](#)).

### **5.3.4 Problem solving**

Problem solving was an important way in which the teacher educators engaged the pre-service teachers. They were able to encourage them to think about things in interdisciplinary ways, to consider creative solutions to problems identified, to work collaborative in designing solutions. So, by enabling the pre-service teachers to work together, consider challenges and come up with solutions they were developing their understanding of design thinking cooperation, future thinking and interdisciplinary thinking ([Table 1](#)).

### **5.3.5 Self-belief**

The teacher educators said that their pre-service teachers had indicated how they had felt empowered to take the topics into schools and confidently teach it. They endeavoured to show how they could

build confidence in their learners by taking small steps and thinking about how their local actions would impact on the wider global challenges being faced by society. Eco-anxiety was one of the things that teacher educators had discussed with their students, and how they had expressed feeling less anxious about doing something that was positive by having a deeper knowledge. By helping the pre-service teachers, it was hoped that they could then pass this onto pupils when they were teaching in schools and as such, demonstrating self-regulation and intercultural competency.

### **5.3.6 Motivation**

The teacher educators said that many students had already made changes to their day to day living with sustainability in mind and would help them support pupils in the classroom. This demonstrates a motivation to continue this learning and teaching. Here, the emphasis was very much on the small scale and small personal or collective actions to make changes.

## **5.4 How does the development of knowledge, values, behaviors, attitudes, competencies and confidence relate to the development of self-efficacy?**

This section will present reflections based on the ways in which this development of knowledge, competencies and confidence described in [sections 5.2](#) and [5.3](#) that demonstrate an impact on the ability to act, thus an indicator that there has been development of self-efficacy in relation to the categories presented [Supplementary appendix B](#).

### **5.4.1 Agency**

Agency is developed through a circular and relational process (Schoon, 2017) because the more individuals have a choice in their own learning, the more they can actively choose how and what they learn. This leads to a greater motivation for learning, thus enhancing an individual's self-efficacy. This process was illustrated by the teacher educators who reported that their pre-service teachers provided evidence of reflecting on the lessons they taught in the classroom following taught university sessions. The development of agency was viewed through the observations from the teacher educators on how their pre-service teachers had stronger confidence in dealing with misconceptions they might come across in the classroom regarding prior knowledge of CCSE. Additionally, these are both key elements in embedding metacognitive competency. From the pre-service teacher perspective, they enjoyed being able to see children they were teaching oversee their own projects and making their own decisions, which had been modelled to them by their teacher educators. Again, modelling and problem solving being a metacognitive competency.

### **5.4.2 Mastery**

Closely related to agency, mastery learning emphasises the benefits of student-centred learning and the importance of building confidence in students through enabling the learner to be aware of their prior knowledge and skills and better know how and what new knowledge needs to be acquired (Block & Burns, 1976). The teacher educators involved in this study provided insight into how the framework prompted their pre-service teachers to critically engage with new information, particularly by examining the topic with a global lens and in a collaborative way to gather a range of perspectives. Constructivist teaching, building on prior knowledge and working collaboratively were all echoed in the reflections by the pre-service teachers.

### **5.4.3 Modelling**

Modelling is a key category for the development of self-efficacy in that it promotes the value of learning through observation (Holland & Kobasigawa, 1980). Observing the demonstration of actions reduces the threat level imposed by learning complex and confusing information which in turn increases the confidence of a learner and makes sense of the instruction (Bandura, 1989). From the reflections of the teacher educators, the pre-service teachers were directed to recognise actions and their impact on a local scale and then encouraged to reflect on how these changes could be made in their own context and in a continued fashion. Vicarious experiences, linking to real life experiences and making use of

waste to produce models for demonstrating ideas to pupils in schools were those things that the pre-service teachers highlighted in the focus group as something they had learnt to do in the teacher education sessions.

#### **5.4.4 Problem-solving**

Being able to problem-solve is a key aspect of self-efficacy. In this study, the teacher educators emphasised the power of collaboration, both with their peers and with their school-based mentors. Reflections demonstrated how pre-service teachers were taught how to problem-solve through learning about all the stakeholders involved in climate change, on micro, meso and macro levels. Thus, self-efficacy of teaching CCSE is enhanced through teaching knowledge to develop a stronger understanding of roles and responsibilities both on a global and local scale. Again, the pre-service teachers acknowledged the importance of challenging pupils, helping the pupils to deal with complexity by considering long term problems and to consider strategic thinking. This was how they felt they had been prepared through their taught sessions.

#### **5.4.5 Self-belief**

When an individual believes they can complete tasks, greater levels of confidence in learning and understanding are constructed (Bandura, 1995). Within this category, the data from the reflections of the teacher educators showed that feeling empowered was a prominent aim and that this empowerment connected to deeper knowledge and reflection on CCSE. Discussing eco-anxiety was deemed to be a positive step and that spending time on sharing thoughts, feelings and perceptions helped individuals to reflect positively on the self. The focus group responses also indicated a sense of taking responsibility and being able to achieve ones' goals was an important aspect for pupils in school.

#### **5.4.6 Motivation**

Lohmann et al. (2021) indicated that motivation is a key part of self-efficacy and that motivation is developed when learners are encouraged and inspired to reflect, express feelings and emotions and then to initiate action and change. Through the data from the teacher educators, this motivation was seen the most through the accounts from the pre-service teachers to their teacher educators on what they had since changed in their own lives after the taught sessions on CCSE. Therefore, the teaching of the framework appears to suggest that the impact reaches beyond the classroom and into the personal lives of the learner. The focus group indicated that they had been able to make practical contributions to projects that they were personally interested in and that this then helped them see how to apply this in a classroom setting with pupils. It was also highlighted that it was important to draw on real world examples, linking this to their own prior experiences outside of teaching.

This article has argued that the development of self-efficacy is underpinned by the development of knowledge, competencies and confidence and that whilst each category of self-efficacy has been considered in turn, that they are clearly interlinked. If links between knowledge and agency (Deci et al., 1991) are considered, the ways in which the teacher educators described how they used mastery to bring in different aspects of knowledge demonstrates this. By using this knowledge and by stimulating the pre-service teachers to reflect and problem solve, the teacher educators were able to help the pre-service teachers to build their confidence and motivation to deliver these ideas in the classroom. Thus, by taking action to do this the teacher educators were demonstrating activism (Jones & Davison, 2021). Through this work, rich insight is provided on how important it is to underpin this development of self-efficacy with competencies (AHE, 2021; UNECE, 2012; UNESCO, 2020) and that in fact, these are also interconnected.

## **6. Discussion**

In exploring the extent to which the pre-service teachers (students) felt that the CCSE framework had allowed them to develop their understanding, competencies and confidence in delivering CCSE we were able to establish that our pre-service teachers in this research had developed their understanding of how to teach climate and sustainability education and through that had developed their confidence in

teaching it. A study by Namdar (2017) used the lens of inquiry based learning in teaching global climate change education to pre-service middle school teachers in Turkey. What she found was that preservice teachers had increased their knowledge which had encouraged action in themselves. If we consider that our approach to CCSE through the ITE framework had similarly asked pre-service teachers to consider climate change and asked them to reflect on why climate change education was important. We had in fact adopted a similar inquiry based approach as Namdar, but that this had not been explicitly phrased in this way. We have phrased it in relation to the metacognitive competencies of problem solving, critical thinking, systems thinking and complexity (Figure 1).

What we were not able to explicitly establish was whether their competencies had been developed. We had inferred this through the connection between increased confidence and improved self-efficacy. Further research would be needed to understand this explicit connection.

In exploring the perceptions and reflections of teacher educators in relation to their pre-service teachers developing the knowledge, values, behaviours, attitudes, competencies and confidence we looked at this through the lens of self-efficacy of the pre-service teachers to embed this into their own teaching. Their agency was developed through confidence and knowledge. That this was particularly enabled through interdisciplinary problem-solving, design thinking and relating learning to real world examples. They had developed mastery through the assimilation of different types of knowledge from different aspects of learning, interdisciplinary thinking and modelling. The pre-service teachers were able to establish self-belief about approaches to teaching this through the understanding of different approaches to reducing eco-anxiety, and the consideration of global issues whilst exploring options for local solutions. Similarly to Namdar (2017) the pre-service teachers were motivated to make changes in their own practices.

Whilst this study is small, it does support the arguments made by Higde et al., 2017; Karpudewan & Khan, 2017; Seow & Ho, 2016 that education has a crucial role in mitigating climate change (in Cebesoy, 2019). What we have shown is the relationship between the different aspects of self-efficacy (agency, mastery, modelling, motivation, problem solving, self-belief - Supplementary Appendix B) and confidence to teach climate and sustainability education. If we link this to the ideas of Vare and Scott (2007) this ITE framework is addressing both Education for Sustainable Development (ESD) ESD 1 (instrumental-anticipatory ESD) and ESD 2 (critical-emancipatory ESD) (in Breitenmoser et al., 2024). Further work needs to be done to explore those dimensions.

There is clearly more work to be done with pre-service teachers in their school settings and linking their understanding to that of the Sustainable Development Goals (SDGs).

## 7. Conclusion and next steps

This research addresses the need for there to be more research into the emerging field of climate education (J. Reid, 2019) and particularly research focused on development of self-efficacy and competencies to promote action in pre-service teacher training in embedding CCSE.

The gaps highlighted by Asshoff et al. (2021) have argued that research to date has primarily focused on knowledge and climate literacy, whilst this research goes beyond that. This research also addresses some of the issues highlighted by Boyes and Stanisstreet (2012) that by having more knowledge about climate change does not necessarily lead to the behavioural changes required to take climate action. The approach highlighted in this research does not just focus on environmental awareness but on pedagogical approaches to develop self-efficacy through metacognitive competencies in pre-service teaching, addressing a gap identified by Field et al. (2019), whilst going beyond the scientific knowledge development as identified by Niebert (2019).

Winter et al. (2022) highlighted that climate change education may be falling behind what exists in schools and is often superficial due to the issues of disciplinary boundaries. This argument for interdisciplinary understanding is also put forward by Anderson (2012). By thinking about an interdisciplinary approach and considering embedding CCSE across all subject specialisms this research is addressing this gap.

One of the biggest challenges was to get 'buy-in' from all stakeholders who needed to engage. This required a framework that was flexible and communicated in a way that demonstrated that. This



allowed academic leaders to take the framework and apply it within their context and programmes in ways that are meaningful. There may be some teacher educators who are skeptical about adding additional material into an already packed ITE curriculum.

The aim of the implementation team was to reassure colleagues, to demonstrate ways, to share ideas and teaching resources, to offer support in teaching of sessions. The idea of simply handing over to an expert was not encouraged although it was important to draw on expertise from experts and to also encourage our whole community to engage in this in developing their own understanding, confidence and knowledge.

The DfE (2022) strategy for sustainability and climate education is not a policy ... therefore how to get buy in? It is complex – people need to learn to be comfortable with complexity – the world is complex and people need to learn to see the connections through problem solving, critical thinking and reflection (Reed Johnson, 2023). Although the research has shed light on the extent to which the pilot implementation of the framework developed self-efficacy in both teacher educators and pre-service teachers the sample size of the data would benefit from being larger to capture data from a wider number of participants and from more institutions in England.

What is of note is that the framework has potential to develop the different dimensions of self-efficacy in pre-service training. This has been demonstrated through the discursive responses from pre-service teachers and teacher educators who took part in this pilot study. It is clear that each category of the self-efficacy themes has been engaged with and made possible through the underpinning metacognitive competencies (for example, systems thinking, interdisciplinary approaches, critical thinking, intercultural, evaluation) as the pedagogical approaches through which the teacher educators engaged their pre-service teachers.

This project shows that the framework can be embedded across initial teacher education curriculum, both within subject specialisms and in interdisciplinary ways. This framework is now being rolled out nationally, demonstrating impact. This change is being driven through multiple stakeholders and collaborative engagement through the NCEAP and across the Department for Education (DfE), Universities Council for Educating Teacher (UCET), national bodies, Higher Education Institutes (HEIs) and School-Centred Initial Teacher Education (SCITT) Providers, Charities who engage in this work from an outdoor or outreach educational perspective; formal examination bodies, and commercial organizations.

There were some limitations to this project in terms of the design of the surveys and the scale. Limitations of the survey were the quality of the questions asked, and the focus group participants were only those pre-service teachers that may have not engaged and is consequently a limitation of this study.

Further research would seek to design a questionnaire focused on these specific aspects of development of self-efficacy and competencies. Likert scale indicators of the different categories of self-efficacy, as well as studies focused on exploring the extent to which pre-service teachers had been enabled through the metacognitive competencies underpinning the approaches adopted by teacher educators could be used. Limitation of the focus group was the size, and those who participated were the more engaged pre-service teachers who had valued the intervention. Further research would need to attract a broader range of pre-service teachers, both engaged and disengaged, to gain deeper and richer insights. Following the study the framework has been made available to all ITE providers across England and the UK, and this will mean that there is a broader potential to access other ITE providers across the UK with differing demographical data.

The next steps for this work are to explore the ways in which this framework fosters inquiry based learning, across both traditional and non-traditional inquiry based learning disciplines (Namdar, 2017); the ways in which ESD 1 and ESD 2 (Vare & Scott, 2007) and competencies are being approached; and the extent to which this framework is able to develop understanding of the Sustainable Development Goals. Consider what questions need to be asked to understand the development of competencies (in particular meta-cognitive competencies).

What are the indicators of behavioral change, in relation to self-efficacy, through these differing approaches? Further research is needed to explore the ways in which 'the gap' (Figure 1) can be



narrowed, by exploring the knowledge about actions and value of taking those actions that then enable individuals or groups to make change.

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## Institutional review board statement

Institutional ethical approval from the University of Reading was obtained prior to the commencement of this study (5 September 2022), following BERA guidelines.

## Informed consent statement

Informed consent was obtained from all subjects involved in the study.

## Authors' contributions

JARJ, SM, AH, NM were involved in the funding application for this research. This paper shares the phase 2 and phase 3 data analysis. Phase 1 has been written about in a previous paper.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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## Data availability Statement

The data collection is for the purpose of developing this paper and further dissemination of the work through conference presentations and networking workshops. Anyone wishing to gain further insight into this phase 2 and phase 3 data can contact author 1.

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