Between Urgency and Uncertainty: The Challenge of Being a Human and an Educator in the Age of Climate Change

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The window in which humans should act to avoid the extreme impacts of anthropogenic climate change is closing. Addressing this crisis requires collective action and political will. Climate change education (CCE) is a global movement and a long-term strategy to empower people to engage in climate action. Educators are at the heart of this movement, tasked with appropriating CCE frameworks to the reality of their context and classroom. This study uses survey data from a research-practice partnership between Teachers College, Columbia University, and New York City Public Schools to explore educators' beliefs, attitudes, and practices on climate change and education. Our findings paint a complex picture. Educators show high levels of concern and negative emotions about climate change, confusion, and underestimation of climate change causes and impacts. Educators support comprehensive CCE in schools and are aligned with international frameworks. While we find growing instructional time dedicated to climate change, the data point to sociological barriers (e.g., perception and labeling of climate change as relevant to the STEM curriculum). We discuss the implications of our findings and offer strategies to enhance CCE in New York City and beyond.

Keywords: Climate change, Sustainability, Climate Change Education, Teacher Beliefs and Attitudes, Instructional Practices, Research-Practice Partnerships, New York City.

Introduction

Scientific consensus views human activity as the primary driver of climate change, particularly through fossil fuel (coal, oil, gas) combustion, land-use change, and unsustainable patterns of production and consumption (Intergovernmental Panel on Climate Change [IPCC], 2023). Adverse impacts from climate change are widespread and affect numerous natural and human systems, including education.[1] Comparative research has documented that exposure to high temperatures during the school year is associated with reduced learning rates across diverse national and subnational contexts, contributing to education disparities linked to climate conditions (Park et al., 2021). Concerns about climate change as a global threat have increased among young people since 2016 (Schultz et al., 2025; von Davier et al., 2024). Students carry these concerns

[1] For review of the multiple impacts of climate change on education, see Global Partnership for Education, 2024.

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into the classroom, where teachers feel responsible for addressing them. Education and public awareness are seen as a climate solution (United Nations [UN], 1992).

Climate change education (CCE) is a global movement to expand high-quality teaching about climate change's causes and consequences to promote meaningful climate action (Reid, 2019; UN Educational, Scientific and Cultural Organization [UNESCO], 2024). Rapid emissions mitigation efforts can slow the process of climate change and reduce the likelihood of continued and intensified adverse impacts (UN Environment Program [UNEP], 2024b). Widespread and equitable implementation of adaptation measures would reduce harm, but the opportunity window to implement changes is short (UNEP, 2024a). Countries can execute these actions if their public is informed and motivated.

As part of broader education efforts such as Environmental Education and Education for Sustainable Development, CCE extends beyond transmitting information to empower individuals with attitudes, motivation, and skills to address climate challenges and engage in collective efforts. International frameworks like the UN Framework Convention on Climate Change (UNFCCC) and the Paris Agreement (2015) recognize the significance of this objective. Article 6 of the UNFCCC (1992) emphasizes education and training as tools to foster public participation toward addressing climate change and its effects. Article 12 of the Paris Agreement highlights the role of education, training, and public awareness to enhance and coordinate climate action globally.

The UNFCCC's Action for Climate Empowerment (ACE) framework encompasses work and strategies to this end and envisions successful implementation as creating "a population whose deep-seated appreciation of the climate challenge leads to greater national action and commitment" (UNFCCC, n.d.). According to the ACE framework, developing pedagogies, curricula, and educator training programs is critical to building broad support for climate action and reducing the ongoing harm and disruption of climate change. However, many education systems have adjusted slowly to climate change and the uptake of CCE practices (UNESCO, 2019). As the group charged with implementing CCE objectives on the ground, educators should be considered as key advocates for a climate-informed and empowered population.

We seek to understand educators' perspectives and commitment (or buy-in) to CCE. We draw on unique data collected through a research-practice partnership between the Center for Sustainable Futures at Teachers College, Columbia University (TC), and the Office of Energy and Sustainability at New York City Public Schools (NYCPS). Our data consists of surveys of school-based Sustainability Coordinators, a group that includes K-12 teachers, administrators, and other staff. We explore how these educators view climate change and CCE: how they understand the causes and impacts of climate change, the qualities and purpose of effective CCE, and how they translate these concepts into practice. Through understanding educators' beliefs, attitudes, and practices, we investigate the gap between international policy discourse about CCE and the local reality as reported by educators. We address four research questions:

RQ 1: What are educators' beliefs and attitudes toward climate change?
RQ 2: What are educators' beliefs and attitudes toward CCE and the role of education in addressing the climate crisis?
RQ 3: To what extent do educators teach about climate change and engage students with it? How do educators incorporate climate change into their teaching?
RQ 4: What factors influence educators' decisions to teach (or not) about climate change?

We aim to advance our understanding of local educational practices within the broader framework of global CCE initiatives in this article. By examining the intricate interplay between educators' personal beliefs, emotional responses, pedagogical beliefs, and strategies, we explore the complexity of teaching about climate change. Our analysis of survey data from New York City Public Schools (NYCPS) not only documents evolving trends over time but also exposes the gap between educators' beliefs and their classroom practices. With this analysis, we seek to bridge the divide between international frameworks and local implementation, offering insights that are vital for policymakers, curriculum developers, and educational leaders striving to integrate meaningful, context-sensitive CCE.

Background

We explore scholarship on teachers and climate change. Chart 1 illustrates the literature and highlights gaps. Growing research has focused on teachers, especially science teachers' knowledge and attitudes about climate change (orange and dark blue shapes). Studies have explored teachers' understanding of climate science, beliefs about its causes and consequences, and how these factors influence instructional practices. Little attention has been paid to the emotional dimensions of climate change and teachers' attitudes toward CCE as a pedagogical endeavor (light blue shapes). Due to the increasing urgency of climate action and the complex social and psychological challenges linked to CCE, a more holistic approach is needed, considering what teachers know, believe, and how they feel about engaging students with this critical issue.

Chart 1

Conceptual summary of literature review

Teachers' Climate Change Knowledge and Attitudes

When engaging in action- and solutions-oriented CCE, educators should emphasize the scientific consensus that the Earth's climate is changing due to human activity (IPCC, 2023). However, research shows that many teachers hold misconceptions about climate change, prioritizing natural, rather than anthropogenic causes of climate change in their lessons (Branch et al., 2016; Plutzer et al., 2016; Plutzer et al., 2024). Some teachers who personally accept anthropogenic climate change still choose to downplay the scientific consensus in their classrooms (Nation & Feldman, 2021). Teachers report gaps in understanding local impacts, the evidence behind scientific consensus, and climate solutions (Sullivan et al., 2014).

Pre-service training and professional development can equip teachers with accurate climate science and increase their confidence in engaging in CCE (Axelrod et al., 2020; Teed & Franco, 2013). Teachers who feel knowledgeable about climate change are more likely to teach climate change (Seroussi et al., 2019), emphasize anthropogenic causes in their lessons (Berkman & Plutzer, 2015; Branch et al., 2016; Plutzer et al., 2016), and perceive fewer barriers to teaching the topic (Ennes et al., 2021). These professional development opportunities are in demand among teachers (Branch et al., 2016; Sullivan et al., 2014). Despite the benefits, teachers often encounter time constraints when considering participation in professional development, a challenge that reflects broader patterns in professional development research (Ennes et al., 2021; da Rocha et al., 2020). Some teachers with limited expertise still engage with climate change in their classrooms (McNeal et al., 2016), while others with strong knowledge may hesitate (Seroussi et al., 2019), suggesting that knowledge alone does not determine climate change instruction.

Climate Change Education Practice

Despite numerous barriers to integrating CCE, educators continue to engage students on this topic. Earth science teachers are the most likely to incorporate climate change topics into their instruction (Wise, 2010), but non-science teachers enhance climate literacy by incorporating interdisciplinary strategies in social studies, language arts (Siegner & Stapert, 2020), and artistic expression (Baker et al., 2013). Beyond content knowledge, CCE fosters essential skills such as research, critical thinking, civic engagement, and decision-making (Ardoin et al., 2017). The literature identifies several best practices, including embedding constructive hope into the curriculum (Ojala, 2015), facilitating deliberative discussions, engaging with scientists, addressing misconceptions, and implementing school or community projects (Monroe, 2017). Effective strategies emphasize collective action (Jorgenson et al., 2019), interdisciplinary connections (Rousell & Cutter-Mackenzie-Knowles, 2019), and real-world applications through project- and place-based learning. Holistic, experiential learning opportunities have been particularly successful in deepening students' understanding of climate issues (Stern et al., 2013), with student-centered approaches yielding the most impactful outcomes (Karpudewan et al., 2014; Stern et al., 2013).

New Directions for Research on Teachers, Climate Change, and Education

Our review of the literature, along with research on public opinion and climate change (e.g., Egan & Mullin, 2017; Leiserowitz, 2007; Shwom et al., 2015), reveals critical gaps that this study seeks to address. Existing research focuses primarily on science teachers, overlooking the role of educators in other subject areas in facilitating CCE, as well as other key adults in schools, such as administrators, paraprofessionals, and support staff. Researchers must expand the scope of inquiry to include a broader range of educators to understand how CCE can be integrated across the school ecosystem.

While research has explored the cognitive and pedagogical dimensions of CCE, it has largely overlooked the role of teachers' emotions in shaping their CCE practice. Emotions and affect certainly influence judgments and behavior related to climate change outside of education (Brosch, 2021). When applied to educators, this influence may manifest in multiple ways: teachers who feel a strong personal connection to climate change may be more motivated to integrate it into their teaching, while those experiencing climate anxiety, frustration, or a sense of helplessness may avoid the topic altogether. Attending to teachers' emotions is important for their well-being and serves as a model to incorporate discussions of emotions and mental health into their teaching of climate change. By recognizing and addressing the affective dimensions of climate education, we can better equip educators with strategies to navigate their own emotions while fostering students' emotional resilience and engagement with climate issues.

Third, existing research lacks a comprehensive exploration of teachers' views on CCE as a global education movement. There is limited understanding of what educators believe should be taught (e.g., causes, consequences, and key skills or competencies), what overarching frameworks should guide CCE (e.g., green career readiness, empowerment, or systems thinking), and what resources and support teachers need to effectively implement CCE in their classrooms.

This study aims to address these limitations by broadening the scope of inquiry beyond science educators, examining the emotional dimensions of CCE, and investigating how teachers conceptualize climate education within a global framework. By filling these gaps, our research will provide valuable insights for policymakers, school leaders, and educators seeking to advance CCE in meaningful and sustainable ways.

Study Setting: New York City (NYC)

We focus on the unique context of NYC for three key reasons. First, NYC already experiences the impacts of climate change, primarily through extreme heat, sea level rise, tidal flooding, extreme rainfall, and coastal storm surges, including Superstorm Sandy in 2012, and low air quality due to fires in Canada in 2023 (Bilefsky, 2023; New York State, n.d). These climate-related events might increase teachers' awareness of and motivation to engage with climate change.

Diversity and deep-rooted inequalities characterize NYC and the NYCPS system. NYCPS serves one of the most racially, ethnically, and linguistically diverse student populations in the United States (U.S.), yet economic disparities shape educational experiences. In the 2023/24 school year, three out of four NYCPS students were classified as economically disadvantaged, with more than a 30-percentage-point gap in economic need across boroughs (NYCPS, n.d.). These inequalities intersect with climate injustices, as predominantly low-income and minority communities are disproportionately exposed to coastal flooding, high heat vulnerability, and environmental injustices, while also facing greater air and water pollution and exposure to industrial sites (NYC Mayor's Office, 2024). The compounded effects of socioeconomic and environmental injustices make NYC a critical case for examining how CCE can address the immediate challenges of climate-related disruptions and the broader structural inequalities that shape students' learning environments.

NYC is widely regarded as a leader in sustainability and climate action. In 2023, the Mayor's Office released *PlaNYC: Getting Sustainability Done*, outlining initiatives for decarbonization, pollution reduction, and a circular economy while also launching new climate education and training programs for public schools. Beyond city-level commitments to CCE, NYC has enacted various policy instruments to promote whole-school sustainability efforts, such as the 2009 mandate requiring every public school to appoint a Sustainability Coordinator (Pizmony-Levy et al., 2021; Verschueren, 2021). While this supportive policy environment creates opportunities for CCE, systemic barriers remain. NYCPS prioritizes student achievement, and its reliance on standardized testing may have a chilling effect on teachers and schools interested in integrating CCE (Menken & Solorza, 2014; Pizmony-Levy & Gan, 2021).

Research suggests that teachers' sociopolitical environments shape their approaches to CCE: when climate change is perceived as controversial, teachers cite this as a barrier to classroom integration (Sullivan et al., 2014). Even educators who strongly affirm anthropogenic climate change may hesitate to engage in CCE due to fears of political backlash or resistance from stakeholders (Nation & Feldman, 2021). The political party of the state in which a teacher works is a stronger predictor of CCE implementation than their individual political beliefs (Khalidi & Ramsey, 2021). NYC presents a unique case where political resistance to CCE is relatively low compared to other parts of the U.S., making it an important setting for examining barriers beyond political hostility, such as curricular constraints, standardized testing pressures, and institutional capacity. Understanding these challenges in a supportive policy climate can provide insights into how to sustain and scale CCE efforts in more politically contested environments.

Data and Methods

Data for this study come from the New York City Partnership for Sustainability Education (NPSE), a research-practice partnership between the Office of Energy and

Sustainability at NYCPS and the Center for Sustainable Futures at TC. The NPSE collaboratively designs studies and collects data through surveys, interviews, focus groups, observations, and document analysis to understand and enhance the role of schools in advancing NYC's sustainability goals. The TC team manages a longitudinal dataset on Sustainability Education in schools, analyzes the data, and supports NYCPS in interpreting findings to inform policies and programs (for additional information about the partnership, see: Pizmony-Levy et al., 2021).

Since the 2019/20 school year, NYCPS has focused on climate change, responding to growing calls for climate action and education. This shift aligns with global initiatives such as the Paris Agreement (COP 21 in 2015) and its Action for Climate Empowerment (ACE) Framework, as well as the momentum generated by the global youth climate movement (e.g., Fridays for Future and the School Strike for Climate).[2] To support this focus, the partnership introduced questions about climate change into its annual survey program (details below), conducted interviews and focus groups with educators, and developed various professional learning opportunities to enhance CCE.

We analyzed data collected between 2020 and 2024 through two types of surveys administered to all Sustainability Coordinators: (a) The Sustainability & Climate Action Plan (SCAP), conducted in the fall (October–November), and (b) the End of Year Sustainability Survey (EYSS), conducted in the spring (May–June).[3] Both instruments are self-administered web-based questionnaires; they cover five key domains: (a) Sustainability Education (including CCE), (b) Communication and Outreach, (c) Health, Wellness, and Green Space, (d) Waste and Recycling, (e) Energy Conservation and Efficiency. The SCAP focuses on assessing needs and intentions for action within these domains, while the EYSS evaluates activities completed throughout the year. Additionally, the surveys include a comprehensive set of background variables (e.g., sex, race/ethnicity, role in school, grade level, subject area, etc.) and attitudes on different issues, providing rich contextual data for analysis. Table 1 shows the availability of climate change and CCE-related questions by survey type and year.

[2] In March 2020, the New York City Council published a report titled *Securing Our Future*, outlining strategies the city could adopt to combat climate change. The report focuses on four key areas: Resiliency, Energy and Emissions, a Sustainable and Circular Economy, and a Green Jobs Pipeline. Among its recommendations, the report advocates for decarbonizing the student bus network, expanding Career and Technical Education (CTE) programs for green jobs, and integrating CCE into all schools. It states: "As keepers of this future, students should be provided with a complete and accurate picture of how human activity affects the Earth and how the world can mobilize to address the impacts of climate change. In a landscape where attitudes toward science have become more hostile, with fear and doubt being used to sow confusion, it is vital for students to be provided with evidence-based education on climate change."

[3] Each year, approximately one-quarter of sustainability coordinators are new to their role. Possibly, some coordinators have participated in the survey multiple times across different years.

Table 1

Availability of Questions by Theme, Survey Type, and Year

Variable/Theme	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022	Fall 2022	Spring 2023	Fall 2023	Spring 2024
Items about CC										
Cause of CC: Human activity vs. Earth's natural cycle			+							
Feeling informed			+			+				+
CC Concern		+	+	+	+	+	+	+	+	+
CC emotions						+				
CC is an important problem in NYC.	+									
Impact of CC				+						
Items about CCE										
Schools should teach CC.			+							
Attitudes about CCE			+							
What should be included in CCE?			+	+						
CCE resources (needs assessment)			+		+					
CC as a topic of interest	+			+		+				
Perception of colleagues' engagement with CCE						+				
Attitudes towards the Climate Action Days initiative								+		+
Definition of "climate action"							+		+	
Items about CCE practice										
Do you teach about CC?			+	+		+		+		+
If yes, frequency of teaching				+		+		+		+
Examples of teaching				+		+		+		
If not, why not?			+					+		
Frequency of talking CC				+		+		+		+
Examples of talking CC				+		+		+		

Items in the sustainability education domain							+	+	+	+
Items about students and CC										
Students' engagement in local Climate Week activities	+				+		+		+	
Perception of students' engagement with CC						+				
Awareness of the global youth climate movement					+					

Note. CC = climate change; CCE = climate change education; shaded background (+) indicates items analyzed in this study.

The NPSE developed climate change-related survey questions based on scholarly research, media coverage, and consultations with key stakeholders. For example, we used close-ended questions from preexisting surveys (e.g., NPR/IPOS, 2019; Yale Program on Climate Communication, 2021). We also borrowed ideas for questions from the OECD's Teaching and Learning International Survey (TALIS) and the IEA's Trends in International Mathematics and Science Study (TIMSS).

Table 2 presents the sample size and descriptive statistics for the socio-demographic composition of the sample, disaggregated by survey type (SCAP and EYSS) and year. The sample includes school-based sustainability coordinators. The sample size ranges from 1,264 to 1,566 respondents and, on average, represents 77% of all NYC public schools. In terms of grade levels, 44% of the sample is drawn from K–5 schools, 11% from K–8 schools, 15.3% from middle schools (grades 6–8), and 29.7% from high schools (grades 9–12). Nearly two-thirds of respondents (65.5%) are women. About half of the sample (47.6%) identifies as white, with a similar representation of Black (17.6%) and Latinx (16.2%) educators. Almost half of the respondents (45.3%) are teachers, while the remainder are assistant principals (27.1%) or hold other school-based roles (27.6%). Among the teachers, approximately two-thirds (62.5%) teach science. One-third of the sustainability coordinators volunteered or self-selected for the role, while the rest were appointed by their principal. Most of the educators (58.4%) have worked at their current school for eight years or more; 32.8% have been at their school between three and seven years, and 8.9% for less than two years.

Table 2

Overview of Sample Characteristics by Survey Type and Year

Variable/Theme	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022	Fall 2022	Spring 2023	Fall 2023	Spring 2024
Sample size	**1466**	**1320**	**1480**	**1332**	**1566**	**1447**	**1394**	**1310**	**1413**	**1264**
Gender (percent)										
Man	28.3	27.5	29.3	28.7	31.5	30.3	28.3	27.8	27.2	26.3
Woman	64.3	66.3	65.2	66.1	62.6	64.2	65.5	65.1	68.0	67.8
Non-Binary	~	~	~	~	~	~	~	~	~	~
I do not wish to disclose	7.1	5.6	5.4	5.1	5.7	5.1	6.0	6.9	4.7	5.6
Race (percent)										
American Indian or Alaska Native	1.2	.7	.9	.6	.7	.9	1.4	.8	.9	.7
Asian American	4.3	4.3	4.9	4.7	5.0	5.0	5.4	5.6	5.0	5.5
Black	18.0	16.4	18.6	17.5	18.8	18.2	16.8	18.2	17.5	16.0
Latinx	14.8	14.4	15.0	15.0	15.7	16.3	17.9	16.4	18.4	18.0
Native Hawaiian	~	~	~	~	~	~	~	~	~	~
White	48.6	47.4	47.5	48.4	44.9	47.7	47.6	47.5	47.7	48.2
I do not wish to disclose	17.1	17.0	16.5	15.3	15.8	14.7	15.8	14.1	12.5	13.9
Not listed	1.8	2.5	2.2	2.8	1.9	2.0	1.9	2.2	2.9	2.4
Role in school (percent)										
Teacher	46.9	44.2	45.5	46.1	43.1	43.8	44.4	44.4	46.5	48.0
Assistant Principal	28.9	28.3	26.3	26.4	27.0	27.3	27.0	26.9	26.1	26.6
Other	24.2	27.5	28.2	27.5	29.9	28.9	28.6	28.7	27.4	25.4
Science teachers (percent out of all teachers)	61.9	62.7	65.4	65.5	59.7	59.6	61.4	60.5	64.1	63.9
Appointment status: Volunteered (percent)	25.8	27.3	29.0	33.5	29.2	29.5	32.0	31.0	31.7	31.9
Years working at school (percent)										
Less than 2 years	9.5	9.8	7.2	6.5	6.4	7.5	9.5	10.1	10.8	11.2
Between 3 and 7 years	32.3	31.9	37.1	36.5	37.2	34.8	31.6	29.4	28.2	28.6
8 years or more	58.2	58.3	55.7	57.0	56.4	57.7	59.0	60.5	61.0	60.2

Results

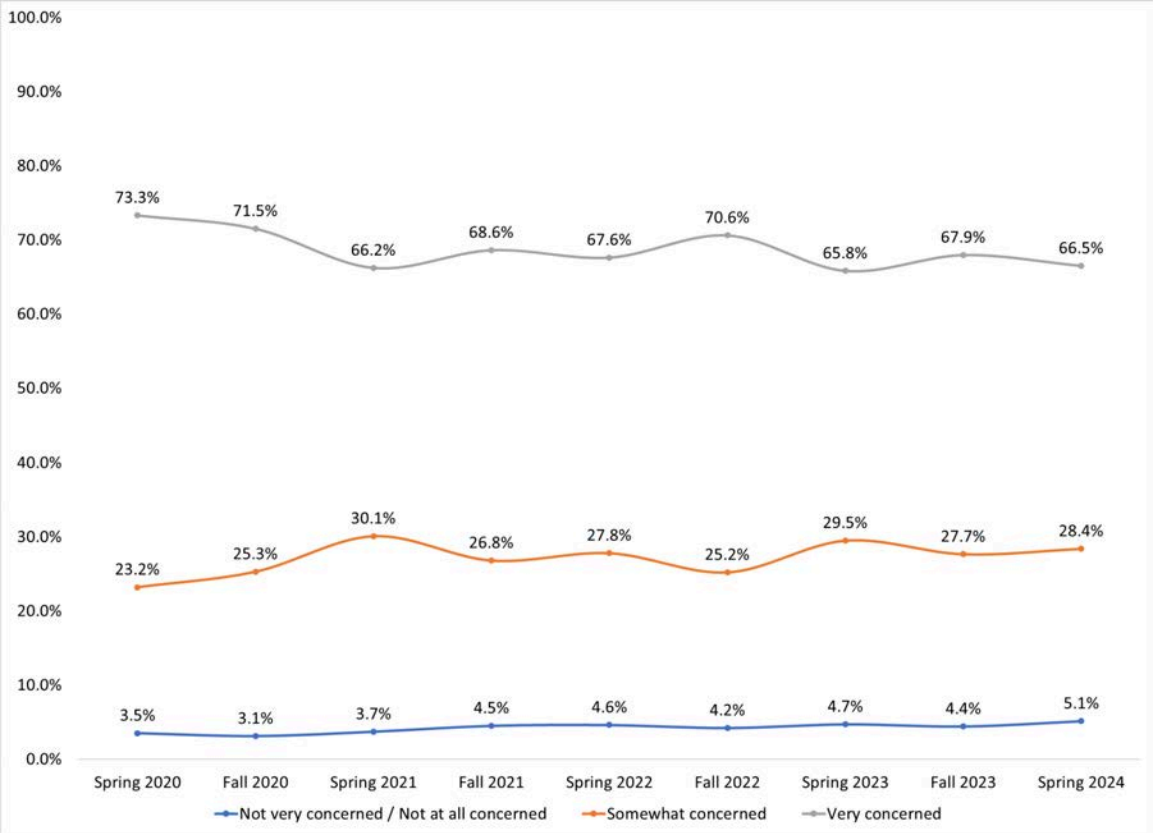
Educators' beliefs and attitudes toward climate change

Climate change poses a threat to ecological systems worldwide. International public opinion surveys indicate growing concern. We begin our analysis by exploring educators' levels of climate concern. As shown in Figure 1, in spring 2020, nearly all educators (96.5%) expressed concern about climate change. A majority (73.3%) reported being "very concerned," while about one-fourth (23.2%) indicated they were "somewhat concerned." A minority were not concerned about the issue, with 2.5% reporting they were "not very concerned" and 1.0% stating they were "not at all concerned."[4] Climate concern among educators remained stable between spring 2020 and spring 2024, with no statistically significant differences observed across the surveys or years.

[4] Given the timing of the survey, conducted a few months into the COVID-19 pandemic, we asked Coordinators whether their level of concern had changed due to the pandemic. Slightly more than one in ten (11.5%) reported that their views had shifted, with the majority of these respondents indicating they were now more concerned about climate change.

Figure 1

Percentage of responses regarding concern about climate change, by level and year

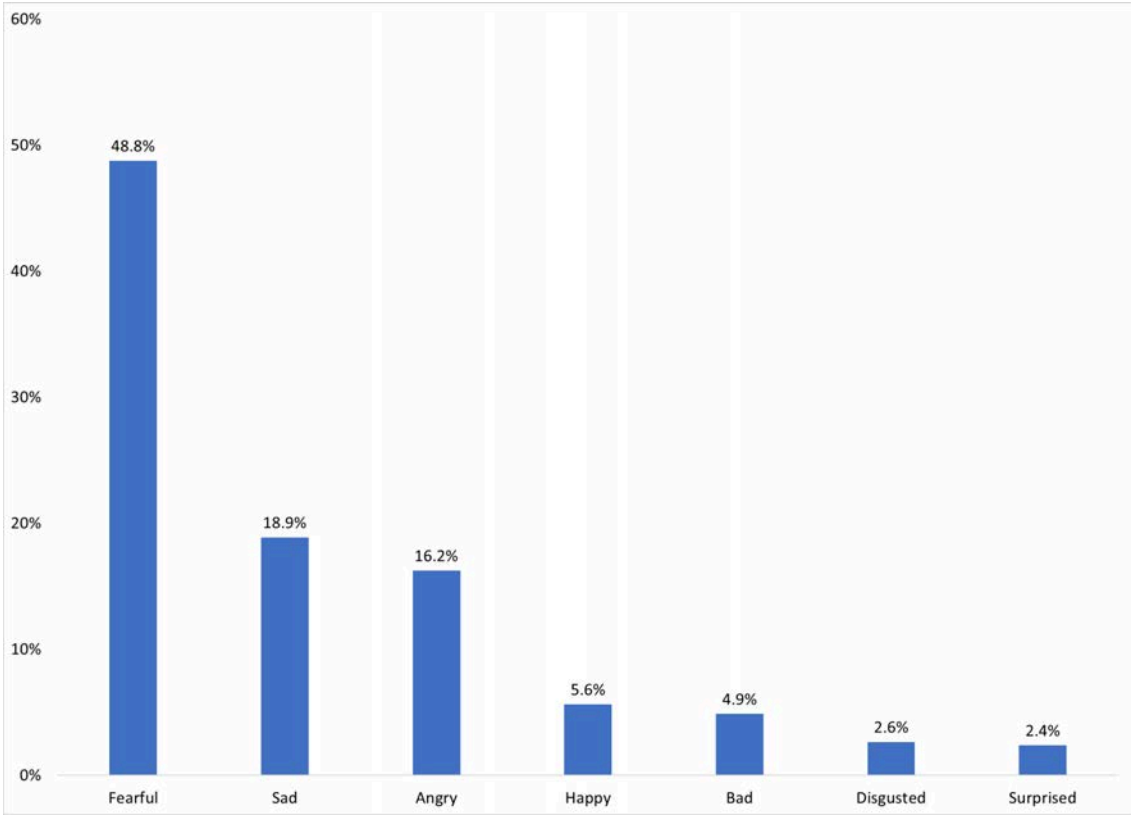


Emotional responses to climate change extend beyond mere concern, encompassing a range of feelings, which we explore in this analysis. In spring 2022, we asked respondents to share the emotions that come to mind when they think about climate change. A significant majority (79%) provided open-ended responses, which we coded and categorized into seven core emotions using a common emotion wheel.[5] The findings reveal that negative emotions overwhelmingly dominate among educators. Specifically, "fearful" was reported by 49% of respondents, followed by "sad" (19%) and "angry" (16%). Other negative emotions include "bad" (5%) and "disgusted" (3%). In contrast, positive emotions were far less common, with "happy" mentioned by 6% and "surprised" by only 2% of respondents.

[5] Emotions can be differentiated from related concepts such as feelings, affects, moods, and sentiments (see Thoits, 1989, for a review). They encompass four key components: (a) an appraisal of a situational stimulus or context, (b) physiological or bodily responses, (c) the expression—whether inhibited or freely displayed—of gestures, and (d) the application of a cultural label to specific combinations of these elements. The emotions wheel provides a structured and nuanced framework for recognizing and understanding emotions. While Panu Pihkala (2022) introduced a Taxonomy of Climate Emotions, this study utilizes a more general emotions wheel developed by Geoffrey Roberts (2015).

Figure 2

Frequency of core emotions when thinking about climate change[6]



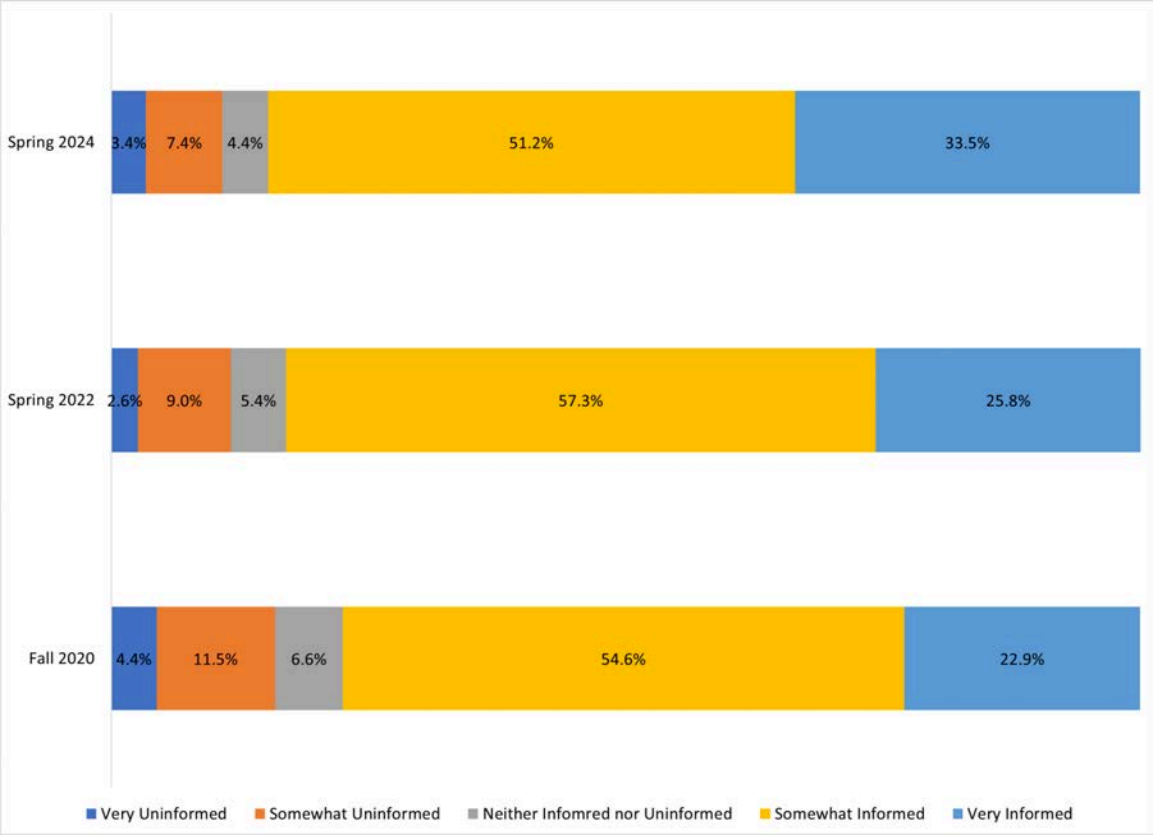
The causes of climate change are complex. Anthropogenic actions (i.e., burning of fossil fuels and deforestation) cause the planet to trap heat by altering natural processes, which are meant to keep the Earth's climate stable (IPCC, 2023). This complexity leaves room for misinformation, and efforts to spread disinformation over the role of fossil fuels in driving climate change further confuse the public. Understanding the causes and consequences of climate change is important to motivate climate action. This is important for educators tasked with engaging students with the topic and thus motivating them to demand change and a better planet.

[6] Fearful (e.g., alarmed, anxious, cautious, concerned, fearful, helpless, insecurity, nervous, panic, pensive, scared, terrified, trepid, uncertainty, worried)
Sad (e.g., apprehensive, defeated, depressed, despair, devastated, discouraged, disheartened, grief, guilt, heartbroken, hopeless, powerless, sadness, shame, unease, unhappy)
Angry (e.g., anger, annoyed, doubtful, frustrated, impatient, mad, outrage, rage, upset)
Happy (e.g., anticipated, calm, curious, determined, empowered, enthusiastic, hopeful, interested, motivated, optimistic, passionate)
Bad (e.g., apathy, bored, indifferent, numbness, overwhelmed, sorrow, stressed, urgency)
Disgusted (e.g., disappointed, discomfort, disgusted, disturbed, dreadful, unsettled)
Surprised (e.g., baffled, confused, cynical, disbelief, surprised, uninformed)

To assess educators' knowledge of climate change, we asked them to indicate how informed they feel about climate change. As shown in Figure 3, educators' perceived knowledge of climate change improved between fall 2020 and spring 2024. At the most recent measurement point, one-third of respondents (33.5%) reported feeling "very informed," while half (51.2%) indicated they felt "somewhat informed." Other respondents fell into the remaining categories, with 4.4% reporting they were "neither informed nor uninformed," 7.4% "somewhat uninformed," and 3.4% "very uninformed."[7]

Figure 3

Percentage of responses regarding feeling informed about climate change, by level and year



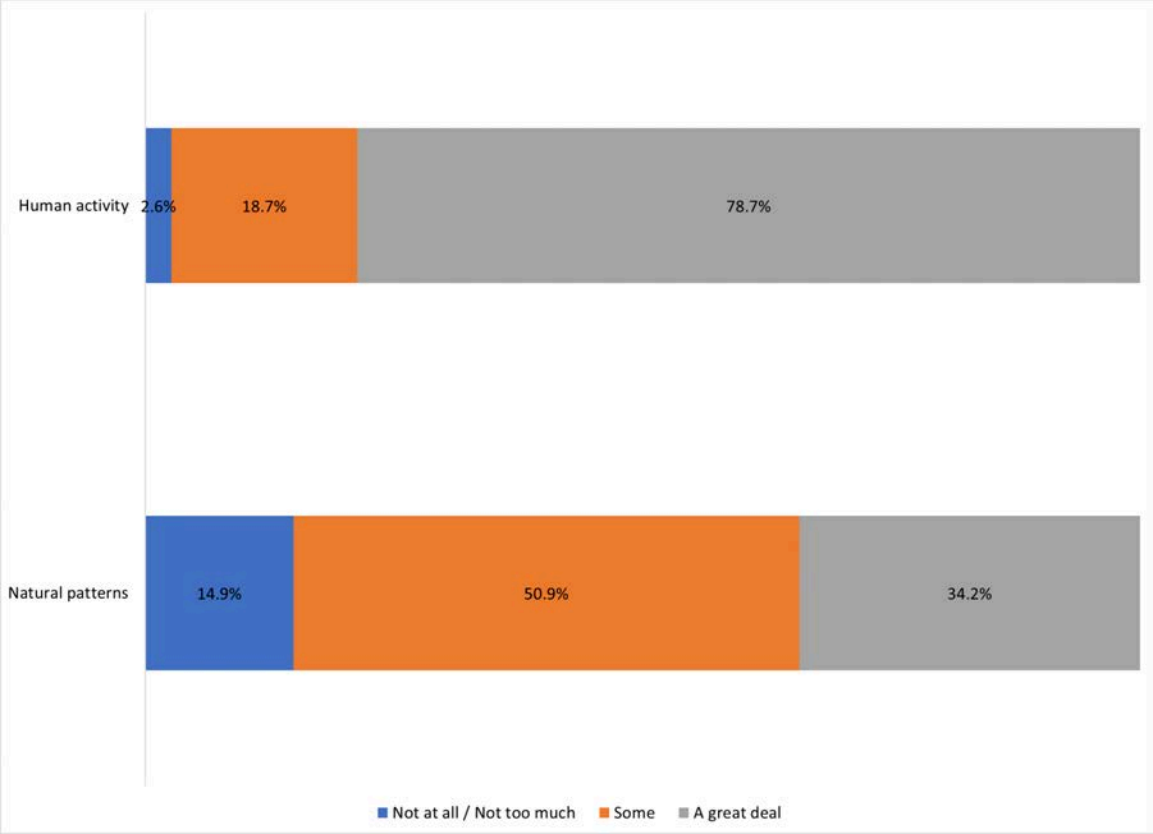
To examine educators' understanding of the causes of climate change, we asked respondents to evaluate the contribution of "human activity" and "natural patterns in the Earth's environment" to climate change. As shown in Figure 4, over three-quarters of

[7] In response to the survey question about which topics educators find most interesting for potential training sessions offered by the Office of Energy and Sustainability, 23% of respondents identified "climate change" as their top choice. While this indicates a notable level of interest, it ranked as the fifth most popular topic overall, suggesting that while climate change is a priority for some educators, other topics may have garnered broader appeal. Less than half of respondents (40.0%) said they would be interested in attending a training about CCE. Climate change is ranked fourth after green teams, growing and eating healthy food, and waste reduction & diversion.

educators (78.7%) think human activity contributes "a great deal" to climate change. About one-in-five (18.7%) thought climate change was "somewhat" attributed to human activity. Only a small percentage thought human actions were "not too much" or "not at all" a factor in climate change (2.6%). A little over a third (34.2%) of educators thought natural patterns in the Earth's environment play "a great deal" in climate change. Over half (50.9%) labeled natural patterns as "somewhat" involved in climate change. About 13.3% of educators thought nature played "not too much" of a role in climate change.

Figure 4

Percentage of responses for the contribution of human activity and natural patterns of Earth's environment to climate change



Another way to examine beliefs about the causes of climate change is to assess responses to both questions simultaneously. Table 3 presents a cross-tabulation in which each cell contains the percentage of respondents indicating the answers to questions. About half of the educators (45.2%) believe that human activity and natural patterns have an equal contribution to climate change (this group is represented on the diagonal of the table). Half of the educators (49.2%) believe that human activity contributes more than natural patterns (this group is represented in the cells below the diagonal of the table). Only five percent of the educators (5.5%) believe that natural patterns contribute more than human activity (this group is represented in the cells above the diagonal). A statistical

test revealed a significant association between educators' beliefs about the contributions of human activity and natural patterns to climate change. This means that their responses to the two questions were related rather than independent.

Table 3

Cross-tabulation of beliefs about the contribution of human activity and natural patterns in the Earth's environment to climate change

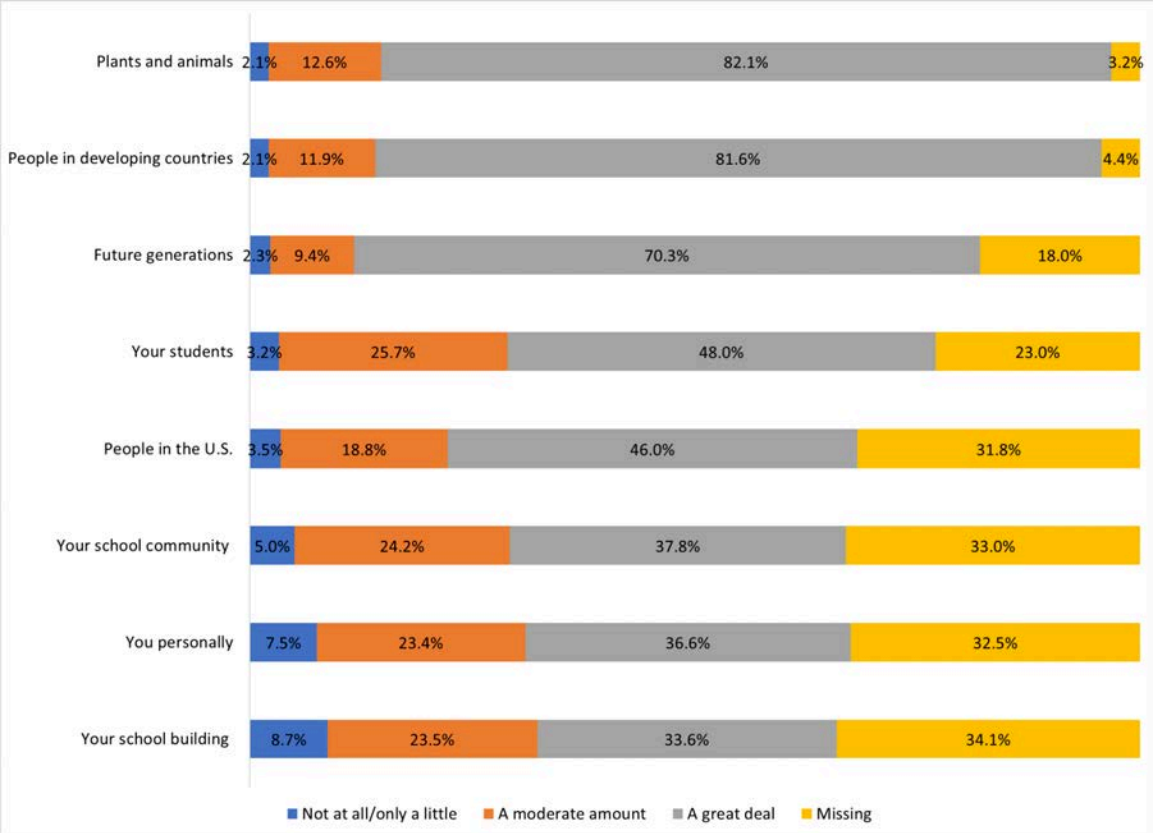
		Natural patterns			
		Not at all	Not too much	Some	A great deal
Human activity	Not at all	.3%	.1%	.3%	.1%
	Not too much	.0%	.5%	1.0%	.3%
	Some	.0%	.6%	14.4%	3.8%
	A great deal	1.3%	12.1%	35.2%	30.1%

Chi^2 = 206.76, DF = 9, $p < .001$, relative frequency of each cell

We asked educators to evaluate the extent to which climate change will harm different groups. Our analysis revealed a significant proportion of missing responses, with participants skipping some questions. To address this, we included the "missing response" category in our analysis. As shown in Figure 5, the majority of educators perceive the future harm of climate change as distant, temporally, and spatially. Most educators believe that climate change will cause a great deal of harm to non-human entities (plants and animals), people in developing countries, and future generations (82%, 82%, and 70%, respectively). Around half of the respondents expect that climate change will cause a great deal of harm to their students and people in the U.S. (48% and 46%, respectively). This figure drops to about one-third when respondents answer about the future harm of climate change to themselves and their school (community and building). We interpret the change in the proportion of missing information as an indication of confidence in answering questions. Educators appear more confident answering questions about non-humans and people in developing countries than those related to people in the U.S., respondents themselves, and their schools.

Figure 5

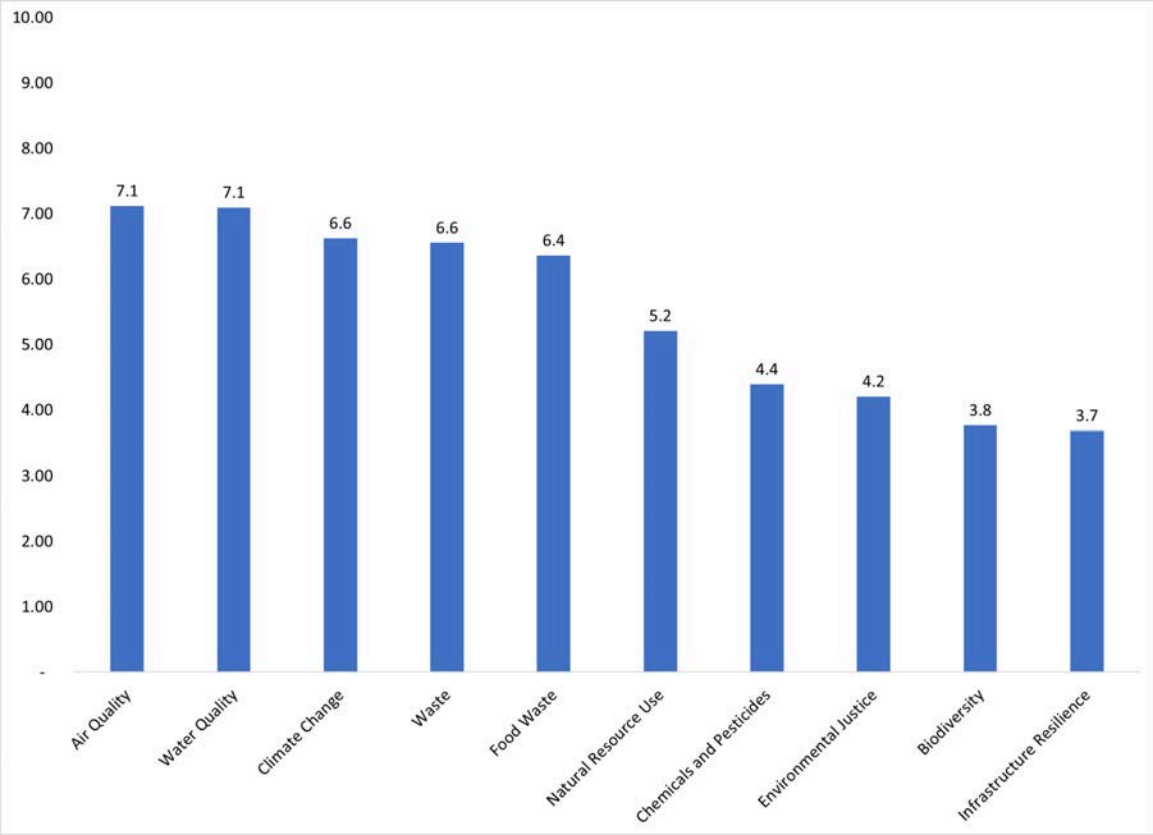
Percentage of responses for the future harm of climate change on different groups



Having explored educators' general attitudes toward climate change, we next turned to their perspectives on environmental issues specific to their local context—NYC. When asked to rank ten environmental issues facing the city, educators identified climate change as the third most pressing concern (Figure 6). About one-third (34.4%) of educators consider climate change the city's most critical environmental problem.

Figure 6

Importance of environmental issues facing NYC (mean)

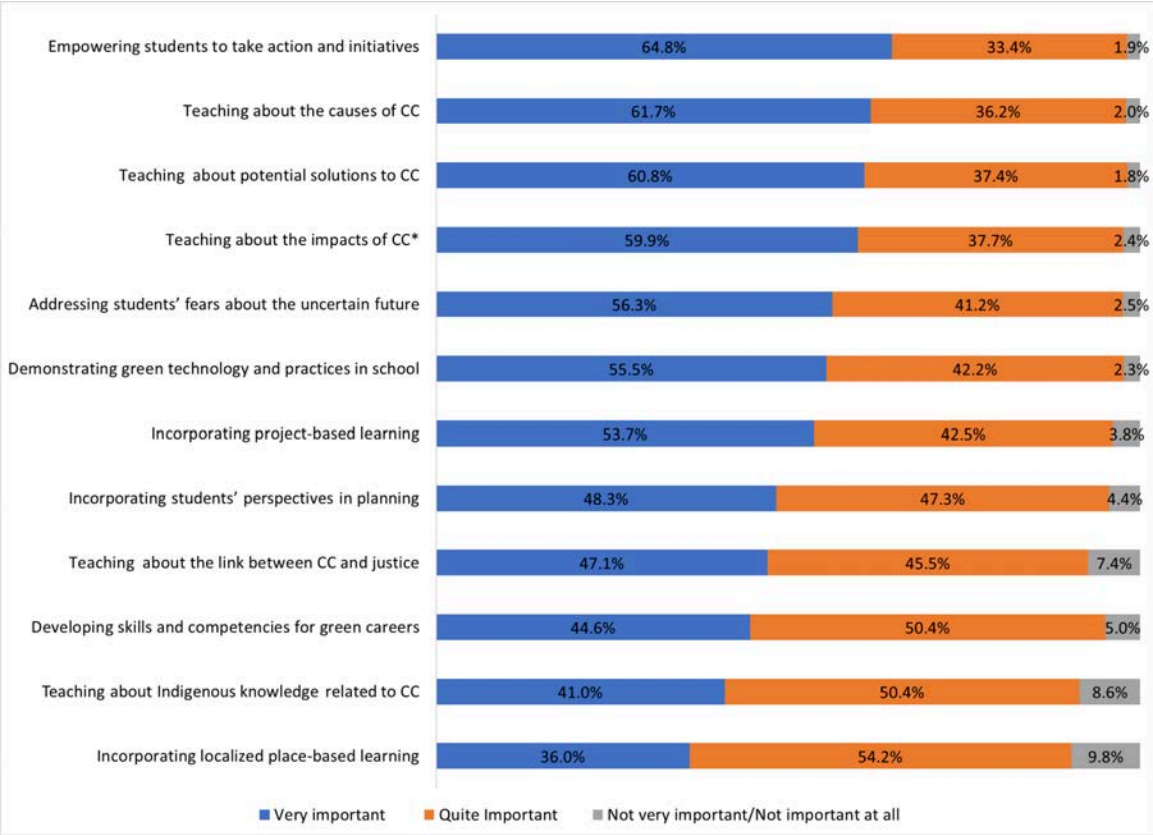


Educators' attitudes toward climate change education

We have examined educators' beliefs and attitudes toward climate change. Now, we explore beliefs about CCE. Nearly all educators in our sample (98.0%) agree that schools should teach about climate change. However, educators differ in how they prioritize various content areas and approaches to teaching about climate change (see Figure 7).

Figure 7

Percentage of responses indicating the importance of different approaches in climate change education



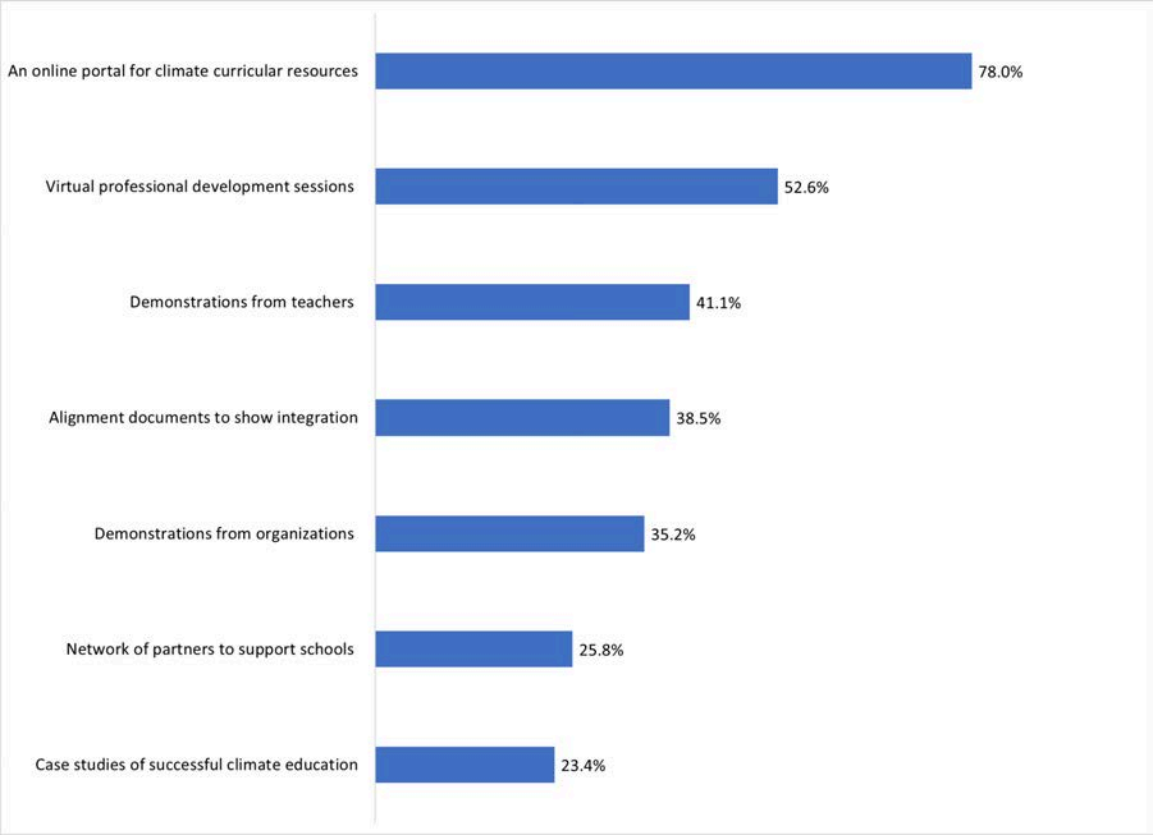
Reflecting international discourse on CCE (e.g., the UNFCCC ACE Framework), the majority of educators recognize the importance of empowering students to take action on climate change (64.8% rated this as "very important" and 33.4% as "quite important"). Similarly, most respondents support CCE that addresses not only the causes of climate change but also potential solutions and its impact (rated as "very important" by 61.7%, 60.8%, and 59.9%, respectively).[8] Educators also emphasize the importance of addressing students' emotional responses to climate change and the uncertainty of the future (56.3% rated this as "very important"). They endorse "hands-on" pedagogies, such as project-based learning and using schools as living laboratories. Compared to other content areas and approaches, however, educators are somewhat less enthusiastic about incorporating Indigenous knowledge and localized place-based learning into CCE.

[8] We explored how educators prioritize the teaching of different types of climate change impacts (available upon request). Educators are more supportive of CCE that addresses the impact of climate change on the environment than on the economy (rated as "very important" by 65.8% and 53.0%, respectively).

To enhance CCE and inform interventions, participants were asked to rate the importance of various resources and indicate their specific needs. A majority (59.5%) identified providing access to instructional materials about climate change as highly important, while 50% emphasized the importance of creating new instructional materials and offering high-quality professional development for teachers. In contrast, 40% considered mapping curricular connections to climate change in all state standards as highly important. Similar patterns emerged when educators were asked about resources they would find helpful for teaching climate change (Figure 8), with strong interest expressed in the virtual delivery of curricular resources (78%) and professional development sessions (52.6%).

Figure 8

Percentage of responses indicating helpful resources to teach about climate change

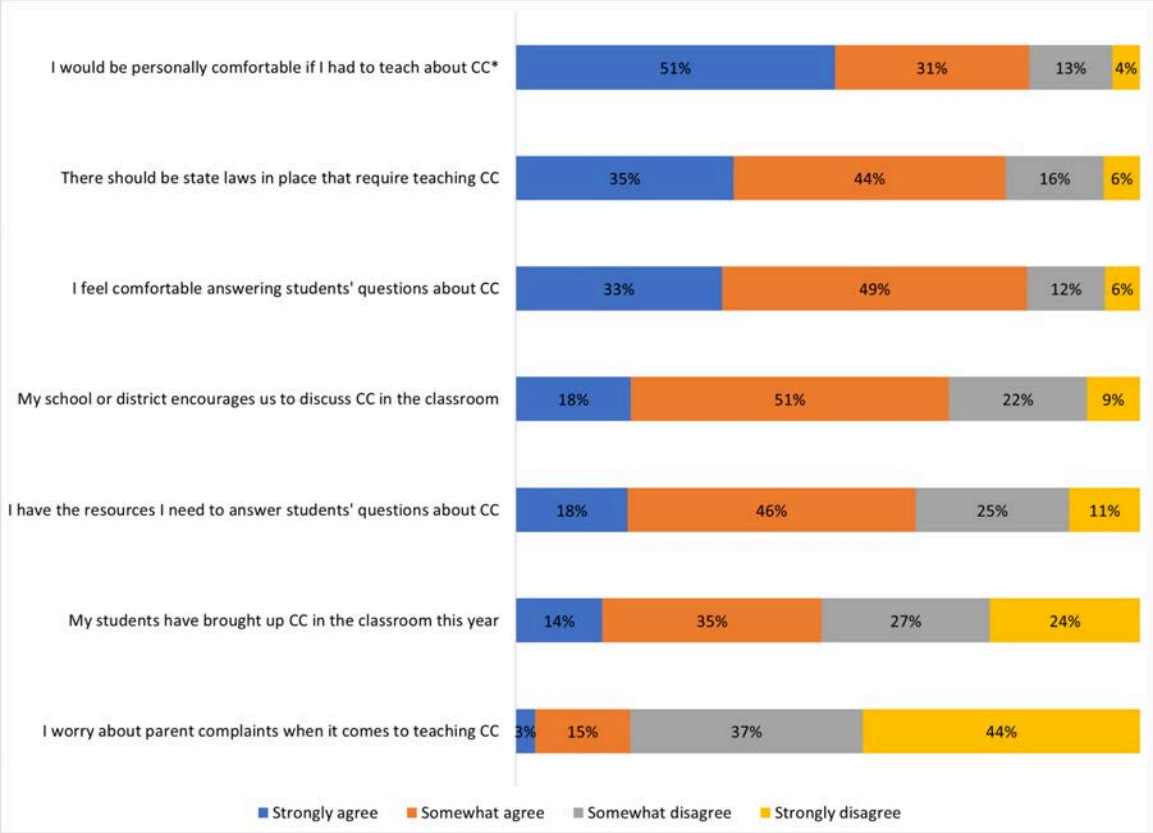


Beyond their views on the curricular aspects of CCE, several other factors influence educators' decisions to teach about climate change (see Figure 9). For instance, the majority of educators (82%) feel confident answering students' questions about climate change. About two-thirds report that their school or district encourages them to teach about the topic (69%), and a similar proportion (64%) indicate they have access to the resources needed to address students' questions. Half of the respondents note that students themselves have brought up climate change in the classroom. Despite this

support, challenges remain. In fall 2020, approximately one in five educators (18%) expressed concern about potential pushback from parents. On the policy front, most educators (79%) support state laws requiring the teaching of climate change, and a comparable percentage (82%) would feel comfortable if the state mandated such teaching. These findings highlight the opportunities and barriers educators face in integrating climate change into their teaching.

Figure 9

Percentage of responses to questions about climate change education

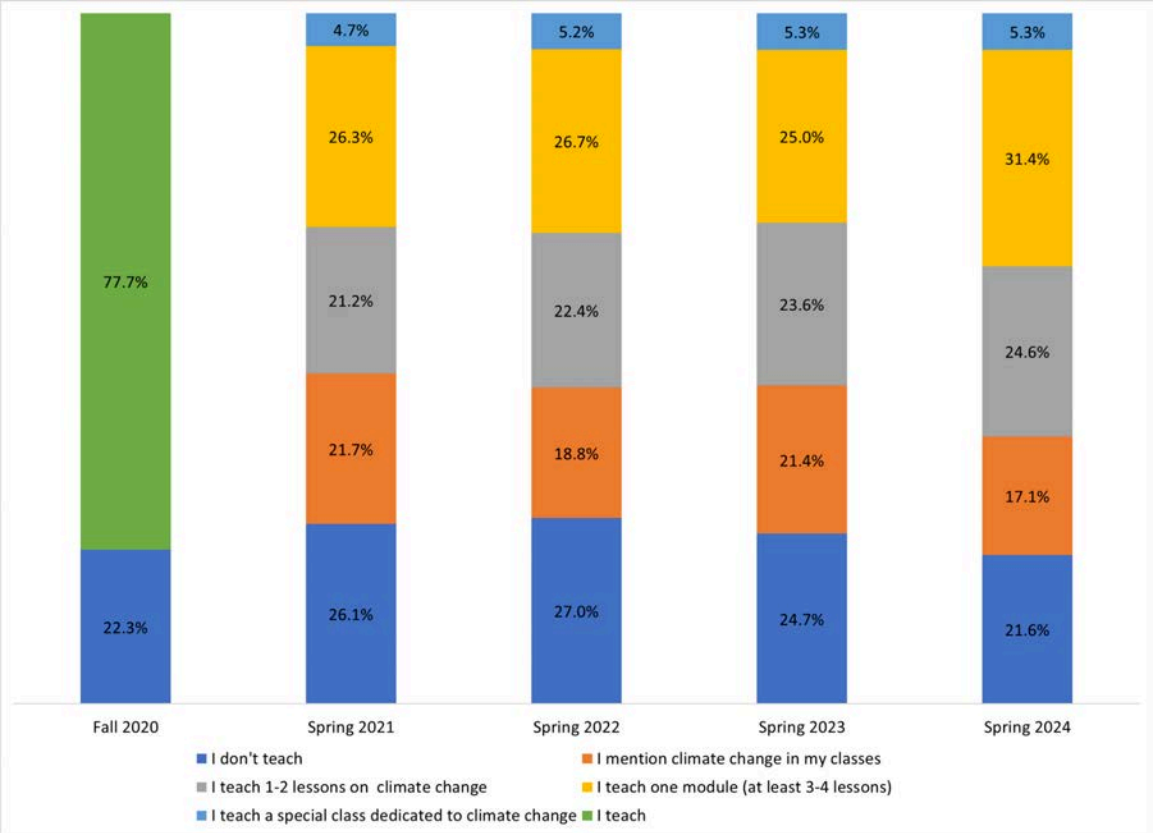


Teaching Climate Change

We examine two key CCE practices: teaching about climate change and engaging in discussions with students about climate change. A majority of teachers in our sample reported teaching about climate change, with more than 70% indicating this practice across all years (see Figure 10). Recognizing that teaching about climate change can take various forms, we asked teachers to specify the extent of their instruction. We observe an increase in the proportion of teachers who report dedicating significant instructional time to climate change, such as teaching at least one lesson (1–2 lessons), a module (at least 3–4 lessons), or a special class focused on climate change. In Spring 2021, 31% of teachers indicated teaching at least three lessons on climate change; by Spring 2024, this figure had risen to 36.7%.

Figure 10

Percentage of responses indicating the extent of teaching about climate change

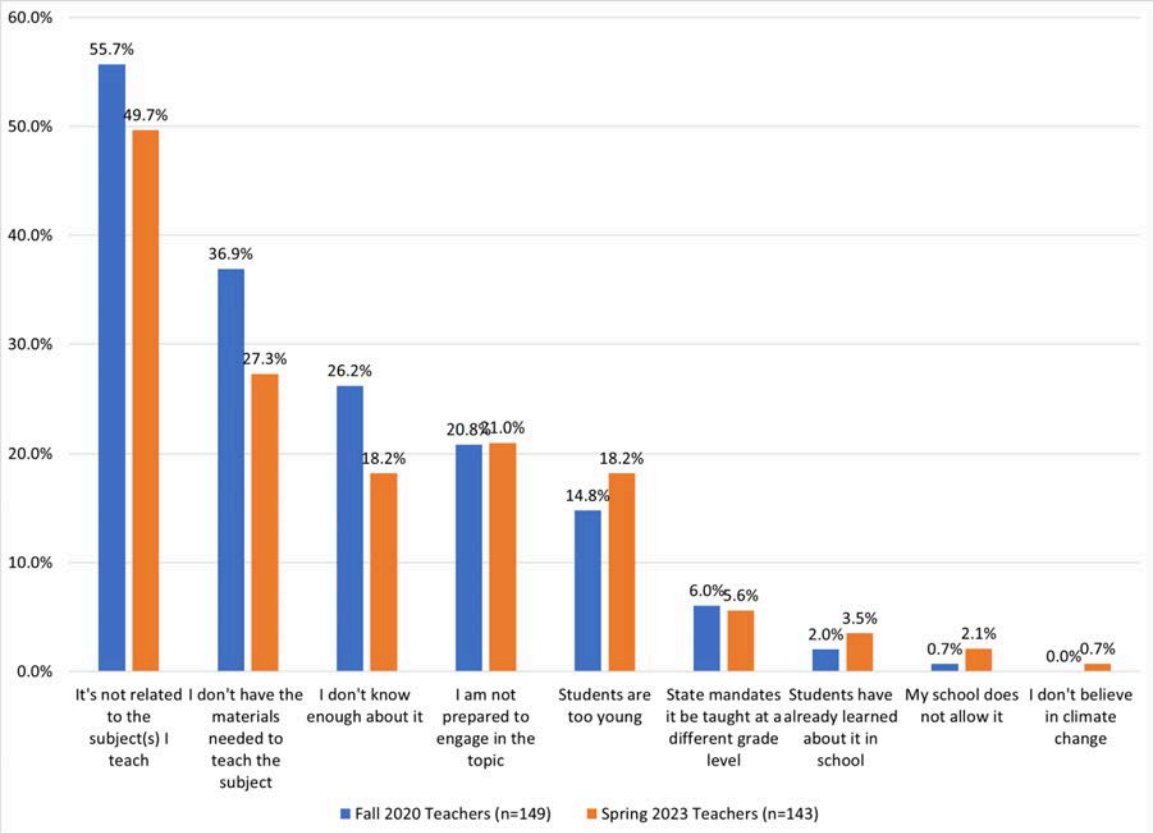


Analysis of the survey data reveals a clear association between grade level and the amount of instructional time devoted to climate change (Chi^2=25.37, DF=8, $p < .01$). Teachers at the middle and high school levels report dedicating significantly more classroom time to climate change topics than their counterparts in primary schools (respectively, 45.4%, 45.0%, and 28.0% indicate teaching at least three lessons on climate change). This pattern suggests that CCE is more frequently integrated into upper-grade curricula, potentially due to subject specialization, perceived student readiness, or alignment with academic standards at those levels.

To better understand the barriers to teaching about climate change, we asked teachers to explain why they do not address the topic (see Figure 11). The most cited reason was the perception that climate change falls outside of their subject area (55.7% in Fall 2020 and 49.7% in Spring 2023). Other frequently mentioned barriers include limited access to appropriate teaching materials, knowledge gaps, and a lack of preparedness to engage students on the topic. Comparing the two time points, we observe a decline in the proportion of teachers citing subject relevancy and access to materials as barriers. However, approximately one in five teachers still report feeling unprepared, which remains a significant barrier for not teaching about climate change.

Figure 11

Percentage of responses indicating reasons for not teaching about climate change



To provide a fuller picture of CCE in NYCPS, we now turn to our qualitative, open-ended response data. In four EYSS (2021-2024), we asked teachers to provide examples of how they teach about climate change. These responses help us to identify common practices and the underlying themes that guide teachers' work around CCE (outlined below).

Science lessons – seamless integration. Teachers were most likely to teach about climate change through science lessons, although science teachers reported varying frequency and depth of their climate change lessons. Teachers highlighted multiple units where they integrate climate change: Alternative Energy Sources, Carbon Cycle, Human Impact on Earth's Climate, Investigating Weather and Climate, Living Environment, Plant and Animal Adaptations, and Urban Agriculture. High school teachers indicated teaching about climate change and related topics as part of their AP Environmental Science Class. Respondents wrote that climate change was "easily incorporated into my science lessons" (Spring 2021) and presented the topic as "a natural fit in many of our science lessons" (Spring 2023).

Multi-disciplinary approach – a pathway for non-science teachers. Fully understanding the climate crisis requires examining historical contexts, cultural influences, social structures, and artistic expressions. Educators across disciplines found creative ways to integrate climate change into their teaching. For example, a fashion design instructor explored climate change by demonstrating "how the fashion industry has helped to create the issues we have today, ways we can combat them, and how we can affect change" (Spring 2021). A literature teacher incorporated realistic fiction, nonfiction articles, and students' climate narratives to "facilitate discussion and encourage problem-solving activities to address environmental inequities" (Spring 2022). A dance educator highlighted the role of the arts in helping students express their concerns and emotions about climate change:

> The Great Kapok Tree Choreography Unit (students choreograph a dance inspired by Amazon Ecosystem, Interdependence) Commotion in the Ocean Unit (students choreograph a dance inspired by Ocean Ecosystems, the effects of pollution, and solutions to the problem) Justice Dances (student write poems about injustice and how to solve it and choreograph interpretive dance solos) Earth Day Dances (students write poems about sustainability challenges we face globally and choreograph interpretive solos) (Spring 2021).

Weaving climate change into the curriculum. Many teachers took a holistic approach to CCE, integrating climate-related topics across multiple subjects rather than confining discussions to isolated lessons. Teachers embedded climate change into science, social studies, English Language Arts (ELA), and mathematics by making connections between climate issues and broader themes such as environmental justice, food security, and energy systems. One elementary school teacher wrote: "As a Science teacher, I infuse the conversation in just about every topic in science […] but I also include these conversations whenever I can into my Social Studies, ELA, and Math lessons" (Spring 2021). Another teacher shared how they used a lesson about the Industrial Revolution to teach how "it changed the way humans live on the planet and consume energy" and the implications for climate change.

Connecting climate change with students' lives. Teachers implemented several key strategies identified by Monroe et al. (2017) in their systematic review of effective CCE approaches. In particular, teachers emphasized making climate change relevant to students by connecting it to their local environment and personal experiences. Many teachers leveraged current events to make climate change tangible: "I use headlines about warming temperatures, rising seas, and stronger storms to help students understand the immediate impacts of climate change" (Spring 2021) and "I tie in weather/natural events like how the current wildfires in Canada are affecting our air quality" (Spring 2023). Others localized climate change effects by relating them directly to students' surroundings: "As we study ecosystems, we also examine our own

community's ecosystem—specifically, how the lack of green spaces impacts air quality and public health" (Spring 2022).

Engaging students about climate change, beyond the classroom, and by non-teachers. Understanding that not all educators in a school teach in a formal capacity (e.g., assistant principals, librarians, parent coordinators), we asked respondents whether they have casual conversations with students about climate change. In general, about two-thirds of educators reported engaging in discussions about climate change with students. Similar to trends in teaching about climate change, we observed an increase over time in the proportion of respondents who reported discussing climate change frequently, sometimes, or often. In Spring 2022, 55.8% of educators, who are not teachers, indicated they talked about climate change sometimes or often; by Spring 2024, this figure had risen to 67.1%.

Our qualitative, open-ended response data is helpful to illuminate the ways that educators engage with CCE beyond the classroom. We asked educators to share examples of when they talked with students about climate change. We found that informal conversations about climate change touch on many of the same topics that curricular CCE addresses, such as temperature rise, extreme weather events, and local/global events (e.g., Earth Day celebration). Educators articulated the inevitability of these conversations:

> This year has been another challenging one. The tracking of temperature change alone and looking at what is currently happening here as well as in other states and countries, and its effects on climate, produce, living circumstances, and environment has been infused into teaching (Spring 2021).

Educators described how conversations about climate change vary across age groups:

> The conversation with students about global climate change is age-appropriate to the students' cognitive or developmental capacity. Older students will challenge and talk more openly depending on their exposure and prior knowledge. [With] younger students, we begin by connecting the kids with nature (Spring 2021).

We found that these conversations often addressed individual actions that students could take toward mitigating climate change. One educator shared that she brings up climate change "when we do [clothing] drives, I explain the importance [of reducing] waste. When students ask me how come I don't eat meat" (Spring 2021). And another educator described engaging in climate change conversation, "When waste is observed or certain behaviors that impact our climate, like littering" (Spring 2022). More often than not, these actions dealt with waste management (recycling, reducing food waste). While waste management is one strategy a community can take to reduce its greenhouse gas emissions, there are many others (sustainable architecture, renewable energy

integration, electrification and expansion of public transport, energy efficiency improvements, food procurement choices, etc.) that have received little to no attention.

Green Teams – potential spaces for climate conversation and learning. Regardless of whether they are teachers or not, educators in our survey mentioned their "Green Team" as a space for engaging students with climate change. Per NYCPS materials, a Green Team is "an independent group or part of Student Government or other school club (e.g., science club) that is dedicated to improving sustainability through projects, awareness, and actions." The composition of Green Teams varies by school. Some consist of students, while others include students and adults, such as teachers and community members. Educators engaged Green Teams in in-depth discussions of the link between climate change and other systems. One teacher, for example, wrote: "I shared a lesson with my Green Team about Edible Gardening wherein we talked about the amount of Greenhouse Gas Emissions due to an industrialized food system, so having local produce would decrease greenhouse gas emissions" (Spring 2022). Educators also used Green Teams to support students in translating knowledge into action:

> I designed a 3-day lesson on Climate Change in lieu of the celebration of Earth Day […] The outcome of the lesson was producing one of the following projects: slogan writing, poster making, write and present a rap song, or write a poem (Spring 2021).

Our findings highlight the diverse ways that educators integrate climate change into their work at school. They adopt creative, interdisciplinary approaches to make climate change relevant and to foster meaningful discussions. From incorporating climate themes into existing subjects to leveraging extracurricular activities like Green Teams, educators find innovative ways to engage students. These efforts not only enhance climate literacy but also empower students to take action within their communities.

Discussion and Conclusion

Responses to climate change—whether through mitigation or adaptation—are widely debated among policymakers, the public, and researchers. The education sector is no exception. While there is growing consensus that education must play a central role in long-term climate strategies, debates persist over how best to leverage K-12 schools, colleges, universities, and non-formal organizations. In K-12 education, a key challenge is integrating climate change across subjects and ensuring that all teachers, regardless of their training or discipline, are equipped and motivated to teach it. In contrast to previous studies that primarily focus on science teachers or teachers' knowledge of climate change, this article shifts attention to the *whole* educator, examining attitudes, emotions, and perspectives on CCE. It also explores how school-based educators, including teachers and other staff, already engage with climate change. Using multiple surveys from an ongoing research-practice partnership, we report on four key findings.

Our study highlights the complexity of how teachers engage with climate change. The vast majority of educators express concern about climate change, with many reporting emotional responses such as fear, sadness, and anger. Educators in our sample exhibit greater concern about climate change than the general U.S. population: 95% of NYC educators are very or somewhat concerned, compared to 65% of Americans (Leiserowitz et al., 2023). Although we have some indication for improvement (see Figures 3 and 11), many educators lack confidence in their knowledge of climate change (with about one-third feeling "very informed" about the topic in the most recent data point). Educators' views on the causes of climate change corroborate this sentiment. While the majority of educators endorse the scientific consensus on the role of human activities (e.g., burning fossil fuels) in climate change, a sizable group also endorses an alternative explanation attributing climate change to natural patterns. About half of the educators in the sample give equal importance to these two competing explanations. Similar to the general public in the U.S., educators tend to underestimate the extent to which climate change will harm them and their local community (Leiserowitz et al., 2023).

Our study underscores widespread support for comprehensive CCE. Educators overwhelmingly support teaching climate change in schools. They prioritize empowering students to take action and addressing causes, impacts, and solutions (see Figure 7). Many value supporting students' emotional responses and uncertainty about the future. However, educators show comparatively less enthusiasm for incorporating Indigenous Knowledge and localized place-based learning into CCE. It is unclear, at this point, why educators present these preferences. Similar patterns are found in public opinion studies in the U.S. concerning support for different aspects of CCE (e.g., Pizmony-Levy et al., 2024). Educators may be reflecting broader societal attitudes toward diverse ways of knowing, or they may be perceiving and adapting to these sentiments in their teaching practices. Educators feel comfortable teaching and answering students' questions about climate change (see Figure 9).

Our study documents the extent of teaching about climate change and the creative ways teachers teach this topic. Compared to other teachers in the U.S., teachers in NYC are almost two-times as likely to say they teach about climate change (40% vs. 77.7%; NPR/IPOS, 2019). Within five years, we observed an increase in the intensity of teaching about climate change in NYC, in that more teachers spend more time teaching about climate change (see Figure 10). Open-ended responses show that science teachers have curricular anchors and templates for engaging with climate change. These educators can point to specific learning units that already address climate change or could serve as an opportunity for this content. Teachers of other subjects shared their practices, detailing how they found ways to connect climate change to their subject.

Our study points to three barriers shaping educators' engagement with CCE: perceptions, access to resources, and feelings of preparedness. Perceptions influence

whether educators integrate climate change into their teaching, with many teachers excluding the topic because they see it as unrelated to their subject area. School leadership and district support appear limited—only one in five educators strongly agree that their school or district encourages them to discuss climate change in the classroom. This lack of endorsement may reinforce the perception that CCE is optional or outside their professional responsibilities. Accessing resources presents a challenge. Teachers highlighted the importance of having the materials needed to teach about climate change (see Figures 9 and 11). Four out of five teachers pointed to an online portal for climate curricular resources (e.g., Subject to Climate or local, district-managed hubs) as a helpful intervention. Feelings of preparedness impact engagement with CCE. One in five teachers who do not teach about climate change cite a lack of preparedness as a key reason. A large group of educators points to professional development sessions and demonstrations from other educators and organizations as valuable tools for effectively incorporating climate change into their instruction. Even when educators recognize the importance of CCE and have access to resources, they may still hesitate to address the topic due to a lack of confidence in their knowledge or teaching strategies.

These findings provide valuable insights into educators' engagement with CCE and raise important questions about how these trends compare to national patterns. Comparing our findings to a nationwide survey of teachers (NPR/IPOS, 2019), we find that teachers in NYC hold more favorable attitudes toward CCE than teachers nationwide. NYC teachers are more likely than their peers nationwide to feel encouraged by their school or school district to teach about climate change (69% vs. 37%, strongly and somewhat agree) and to recognize students' interest in the topic (49% vs. 41%, strongly and somewhat agree). NYC teachers are less likely than their peers nationwide to worry about parental complaints related to climate change instruction (18% vs. 29%). Context matters. NYC's relatively environmentally progressive policies and culture appear to influence how educators engage with CCE. Interventions should be tailored to local contexts, ensuring that support for CCE aligns with regional attitudes and policies.

What explains the improvements in teachers' climate change knowledge and their engagement with CCE over time? Several factors may contribute to these positive trends. First, increased public discourse and awareness around climate change (Leiserowitz et al., 2023; Tyson et al., 2023) have likely influenced educators' perceptions and knowledge. As climate change continues to be a prominent issue in media, politics, and public discussions, teachers are exposed to more information, which may contribute to their growing confidence in understanding and teaching the topic.

Second, local policy and programming may play a role. NYCPS has introduced CCE-focused initiatives in schools, including professional development opportunities (e.g., workshop series, and Mid-Winter Climate Institute) and city-wide campaigns (e.g., four Climate Action Days per year starting in the 2023/24 school year). NYCPS

convened the Climate Education Leadership Team (CELT), a group of over 30 educators who help design professional learning, develop curriculum resources, and build a citywide network to support the integration of equitable climate education across all subjects and school communities. These efforts may have helped equip educators with the knowledge and tools to integrate climate change into their teaching. As more teachers begin to engage with CCE, they share ideas, resources, and best practices with colleagues, fostering a ripple effect that enhances teacher preparedness.

Third, student activism and interest in climate issues may motivate educators to prioritize climate change in their instruction. With student-led climate movements gaining momentum, educators may feel a greater responsibility to respond to student inquiries and integrate climate-related topics into their teaching. Taken together, these factors help explain the positive trends in teachers' climate knowledge and teaching practices, underscoring the importance of sustained institutional support, professional learning opportunities, and responsive education policies in further advancing CCE.

Our study is a step toward a more comprehensive understanding of educators' engagement with CCE. Our study draws on data from a specific context—NYC, a global city within a high-income country—and from educators who are appointed or responsible for advancing sustainability initiatives at their schools. While this provides valuable insights from the majority of the schools in the NYC system, it does not capture the full spectrum of teachers and school staff who may engage with CCE in different ways. Future research could include data from representative samples of teachers and educators to ensure a broader and more generalizable understanding of CCE. Research should incorporate more qualitative data, such as interviews, focus groups, and classroom observations, to better understand how teachers make sense of climate change and navigate the broader educational landscape, including policies and practices related to CCE. Expanding the scope to multiple contexts will also be critical for examining how socio-political and educational environments shape teachers' engagement with CCE. International large-scale assessments such as TIMSS 2023 (von Davier et al., 2024) and TALIS 2024 provide valuable opportunities for cross-national and comparative analyses, enabling a deeper exploration of these dynamics on a global scale. Integrating data from diverse contexts and representative samples, future research can offer a more nuanced and comprehensive picture of the challenges and opportunities in advancing CCE.

This study provides valuable insights into conducting research within the context of a research-practice partnership. Through ongoing dialogue and a shared commitment to learning from each other, our partnership evolved from a broad focus on sustainability to a targeted emphasis on CCE. We learned a key lesson from this collaboration: how to collect comprehensive data on educators—their emotions, attitudes, and instructional practices—without overwhelming participants with lengthy survey instruments. By working closely with district leaders, we were able to refine our approach (see Table 1) and ensure that data collection remained meaningful and manageable. Because this

study was embedded within a research-practice partnership, we were able to translate findings into action quickly. For example, we co-designed a Summer Institute*:* Integrating Climate Change in NYC Public Schools (Gardner, 2023). Findings from our study directly informed the objectives and content of the Institute, in which we sought to: deepen teachers' understanding of climate change through direct engagement with climate scientists, empower teachers to integrate climate change across diverse subjects by connecting them with curriculum experts from TC and NYCPS, build a supportive learning community of educators from across the city, fostering sustained collaboration, and co-create innovative teaching materials tailored to NYC's unique educational context. This experience underscores the power of research-practice partnerships in bridging the gap between research and implementation, ensuring findings are academically significant and practically impactful.

CCE has evolved as a field over the past decades, shaped by international frameworks such as Action for Climate Empowerment (ACE). While these global discourses provide valuable guidance, it is crucial to pay close attention to what happens on the ground—how educators experience, interpret, and implement CCE in their daily work. This study contributes to this effort by taking a whole-educator approach, examining not only teachers' knowledge and instructional practices but also their emotional responses to climate change and attitudes toward CCE. By centering educators' perspectives and lived experiences, we gain a richer understanding of both the opportunities and challenges in advancing CCE. Continued attention to teachers' needs, grounded in local realities and collaborative partnerships, will be essential in shaping effective and sustainable climate education initiatives.

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