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Orientations of Chinese Geography Teachers Towards Climate Change Education

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ABSTRACT

In 2017, China introduced a competencies-based senior high school geography curriculum emphasizing the Sustainable Development Goals (SDGs), particularly global climate change. Geography textbooks present climate change as an exemplary case, integrating standards on climate systems, climate change and sustainable development. This study investigates how fifteen secondary geography teachers prioritize learning goals for climate change education and the rationale behind their choices. Five teachers aimed to fully implement the curriculum, six selectively incorporated elements to align with their personal preferences, and four sought to transcend the curriculum by emphasizing transformative-emancipatory goals. Some teachers underscored the importance of fostering a sense of community to work toward a common future. However, they also expressed hesitations about encouraging sustainable behavioral change, as it might interfere with parental authority. These considerations have not been identified in previous research conducted in Western countries. Therefore, our findings underline the importance of taking contextual factors into account when studying teacher orientations.

KEYWORDS

PCK; orientation; geography teachers; climate change education; China

1. Introduction

Climate Change (CC) is one of the most pressing challenges facing humanity, with mitigation and adaptation often described as a “wicked problem par excellence” (Termeer, Dewulf, and Breeman 2013). As a result, teaching about CC presents a significant challenge for educators (Tabor and Harrington 2023).

Academic literature, along with several international organizations, advocates for integrating CC education within the broader framework of sustainability education (Mochizuki and Bryan 2015). However, sustainability education encompasses a wide range of approaches rather than a single, uniform model (Papenfuss et al. 2019).

Geography is a well-suited school subject for CC education in many countries (Chang and Pascua 2017; Clausen 2018; He, Tani, and Puustinen 2024), as it focuses on humans and their living environment (Taylor and O’Keefe 2021). China’s new geography standards primarily emphasize the climate system, including the causes, mechanisms, effects and management of CC, as well as its broader societal implications. Geography textbooks also cover both the physical and societal dimensions of CC.

CC education can help develop student’s knowledge, skills, values and attitudes, preparing them to become responsible future citizens, change agents, policymakers or influencers (Kuthe et al. 2019; Sund and Öhman 2014). Three key concepts are essential in CC education: the

conflation of weather and climate, the differences in spatial and temporal scales of climate, and the distinction between natural climate variability and human-driven climate change (Tabor and Harrington 2023).

The actual practice of teaching CC is influenced by multiple factors, including the curriculum context, learner characteristics, and, most notably, teachers’ pedagogical content knowledge (PCK) (Shulman 1986). Since Shulman introduced the concept of PCK, it has been refined and expanded by many education researchers. Magnusson, Krajcik, and Borko (1999) conceptualized science teachers’ PCK into the following five components: (1) orientations toward science teaching, (2) knowledge of the science curriculum, (3) knowledge of students’ understanding of specific science topics, (4) knowledge of assessment in science, and (5) knowledge of instructional strategies for teaching science. In their conceptual model for the knowledge base for geography teaching, Hong et al. (2018) added a sixth component: knowledge of educational contexts.

The orientation component includes beliefs about the goals and purposes of education (Brooks 2010; Tuithof 2017). As teachers’ orientations shape how they develop and apply their knowledge, empirical research on their perspectives toward CC education is essential for a deeper understanding of current teaching practices.

Although the orientation component of PCK has been defined in various ways, there is a growing consensus that it primarily encompasses beliefs about the purposes and goals

of education and beliefs about effective teacher-student interactions (Friedrichsen, Driel, and Abell 2011). Based on interviews with science teachers, Magnusson, Krajcik, and Borko (1999) identified nine distinct teaching orientations: process, academic rigor, didactic, conceptual change, activity-driven, discovery, project-based science, inquiry, and guided inquiry. Similarly, within the context of history teaching in the Netherlands, Tuithof (2017) identified eight instructional strategies and teaching orientations from interviews with experienced history teachers: cultural stock-in trade, historical reasoning, overview of time, perspective-taking, entertainment, moral lessons, explaining current affairs, and preparation for academic or scientific thinking. Tuithof (2017) found that a teacher's orientation guides how they apply knowledge from the other four components of PCK. For example, a history teacher with a "historical reasoning" orientation is more likely to design tasks that require students to analyze different resources. For the subject of school geography, the PCK of teachers, including its orientation component, has been examined by several scholars. For example, Catling (2004) administered questionnaires with open-ended questions to trainee primary school teachers in England. His research showed that some trainees view geography education primarily as the study of places, while a slightly larger group considers developing children's sense of responsibility for the Earth and its people most important. Another substantial group sees geography as a subject focused on imparting knowledge about the world's features and countries. However, the largest group perceives geography's main role as fostering young children's awareness and understanding of the environment. In the conceptual model of the teacher knowledge base proposed by Hong et al. (2018), orientation is defined by two questions: "What is geography?" and "Why do you think students need to learn geography - for what purposes?" Hong et al. (2018) distinguished seven orientations: globalists, earthists, interactionists, placeists, environmentalists, facilitators and synthesizers. Interviews with four geography teachers revealed that they combined several orientations.

A literature review on geography teachers' PCK by Smit et al. (2023) revealed that only a few empirical studies have specifically examined the orientation component in relation to CC education. In one such study, Clausen (2016) conducted surveys among Danish geography teachers, finding that they consider not only CC knowledge assessed in final exams - a qualification goal (Biesta 2020) - but also empowerment of students to formulate their own opinions on CC issues, reflecting a socialization and subjectification goal (Biesta 2020). Seow and Ho (2016) conducted semi-structured interviews with ten geography teachers in Singapore. Four of these teachers prioritized promoting sustainable values and deliberately avoided presenting controversial information to prevent confusion or doubt about the anthropogenic causes of CC. The remaining six teachers focused on developing students' critical thinking skills and provided multiple perspectives. A survey by Howard-Jones et al. (2021) of 626 primary and secondary school teachers from various subjects in the UK showed that most agreed the causes, mechanisms and effects of CC should be introduced in primary

education. Also, the majority supported fostering civic competences related to CC, such as participation in local mitigation projects. Notably, there was considerable support for disruptive activities, with 54% of teachers agreeing that participation in civil disobedience should be part of the curriculum.

Recent research on teacher orientations with regard to CC education in the Netherlands by Duindam et al. (submitted) and Favier et al. (2024) found that only one of the 19 interviewed teachers explicitly advocated for sustainable behavior, while some preferred to encourage it indirectly. However, most teachers aimed to promote well-considered behavior rather than direct advocacy. For many, beliefs about the neutrality of education outweighed concerns about the urgency of sustainable transformation.

Research on geography teachers' orientations toward CC education is limited and has been conducted primarily in Europe and North America (Rousell and Cutter-Mackenzie-Knowles 2020; Smit et al. 2023), with the exception of Singapore (Seow and Ho 2016). In China, little empirical research has been conducted on geography teacher orientations. Previous studies on CC education in China have predominantly focused on comparing curriculum requirements and documenting teacher experiences with CC lessons (Guo et al. 2018). The current Chinese curriculum aims to foster the development of global competencies. Gaining insight into geography teachers' orientations toward CC education will help broaden our understanding of teacher's considerations and challenges across multiple contexts.

The main objective of this paper is to explore the orientations of geography teachers in senior high schools in China, with a focus on CC education. Our study was guided by the following questions: (1) What goals and purposes related to CC do geography teachers prioritize, and why? And (2) How do teacher orientations relate to the new geography curriculum?

2. Literature on approaches in CC and sustainable development education

Previous research on teachers' PCK related to CC has interpreted their perspectives using concepts from sustainable development (SD) education literature. McKeown et al. (2002) and Duindam et al. (2014) argue that sustainability education can be categorized into two main approaches: "education *about* SD" and "education *for* SD." While the former follows a transmissive approach, emphasizing the transmission of knowledge, the latter is more transformative (Papenfuss et al. 2019), as it aims to equip students with the knowledge, skills, attitudes and perspectives needed to contribute to a more sustainable world (UNESCO 2021).

Nolet (2015, 87) describes "education *for* SD" as "a means to an end," serving as an instrument to achieve objectives set by governments and international organizations. However, education *for* SD has faced criticism (Evans, Welch, and Swaffield 2017; Sund and Öhman 2014; Young 2003). Critics argue that it imposes a single pathway toward a "better" world while failing to promote reflexivity, critical thinking

and student engagement with their own interests (Huckle 2009; Jickling and Wals 2008; Sauv   and Berryman 2007).

As an alternative, some scholars advocate for a more pluralist and open-ended approach that allows learners to make their own choices. Vare and Scott (2007) refer to this as “education *as* SD.” Several scholars argue that CC education should follow such a transformative approach (Mochizuki and Bryan 2015).

Cantell et al. (2019) introduced the “bicycle model” for CC education, a holistic framework that integrates multiple key components, including knowledge, thinking skills, values, identity, worldview, action, motivation, participation, future orientation, hope and other emotions, and operational barriers. Effective CC education strategies involve engaging students in deliberative discussions, facilitating interactions with scientists, addressing misconceptions, and implementing projects within schools or communities (Monroe et al. 2019).

Papenfuss et al. (2019) synthesized the SD education approaches in a model with two dimensions: transmissive versus transformative and instrumental versus emancipatory. Favier et al. (2024) modified the model from Papenfuss et al. (2019) (Figure 1A) to classify the orientations of Dutch geography teachers toward CC education. Their interviews revealed both similarities and differences between CC education and SD education. Most notably, only some teachers primarily viewed CC as a sustainability issue. These teachers aimed to promote a more sustainable planet by influencing behavior directly or indirectly through fostering a sense of commitment.

Other teachers saw CC primarily as a geographic issue, believing it belonged at the core of the subject and that students should therefore develop knowledge about CC. Some viewed CC as a context for enhancing geographic literacy, focusing on geographic thinking, research, and problem-solving skills. Finally, some teachers saw CC as a way to foster students’ autonomy, aiming for well-considered behavior.

Favier et al. (2024) argued that CC education should also include approaches that are even more open-ended than the

“education *as* SD” approach described by Vare and Scott (2007), in which students explore not only *how* but also *whether* they want to contribute to SD. This perspective aligns with an “education *for* autonomy” approach (Figure 1B).

The theoretical framework proposed by Favier et al. (2024) served as a prototype for our investigation into geography teachers’ orientations toward CC in China. However, the applicability of this framework remains uncertain, as the emancipatory-transformative approaches are typically associated with Western liberal-democratic values. China presents a markedly different context, as its society is rooted in Confucianism, a system characterized by rigidity, authoritarianism, and a lack of democratic structures (An 2000). Although the dominant political and economic climate has shifted toward free-market capitalism, educational curriculum control remains highly centralized and authoritative (Hawkins 2000).

Over the past two decades, China has implemented two sequential curriculum reforms as key strategies for addressing twenty first century challenges. The state plays a pivotal role in shaping curriculum-making mechanisms and influencing the social distribution of knowledge, skills and dispositions through these reforms (Law 2014). Understanding how geography teachers navigate this educational landscape is essential for expanding international discussions on CC education. This study, therefore, contributes a Chinese perspective to the broader literature on geography teachers’ orientations toward CC education.

3. Climate change education in the Chinese secondary geography education

In the People’s Republic of China, geography is a compulsory subject for students aged 12–15 and an elective subject for students aged 16–18 (Brooks, Qian, and Salinas-Silva 2017). The national curriculum standards serve as the bedrock for textbooks authors, guiding teachers in their pedagogical approaches and establishing the criteria for assessment

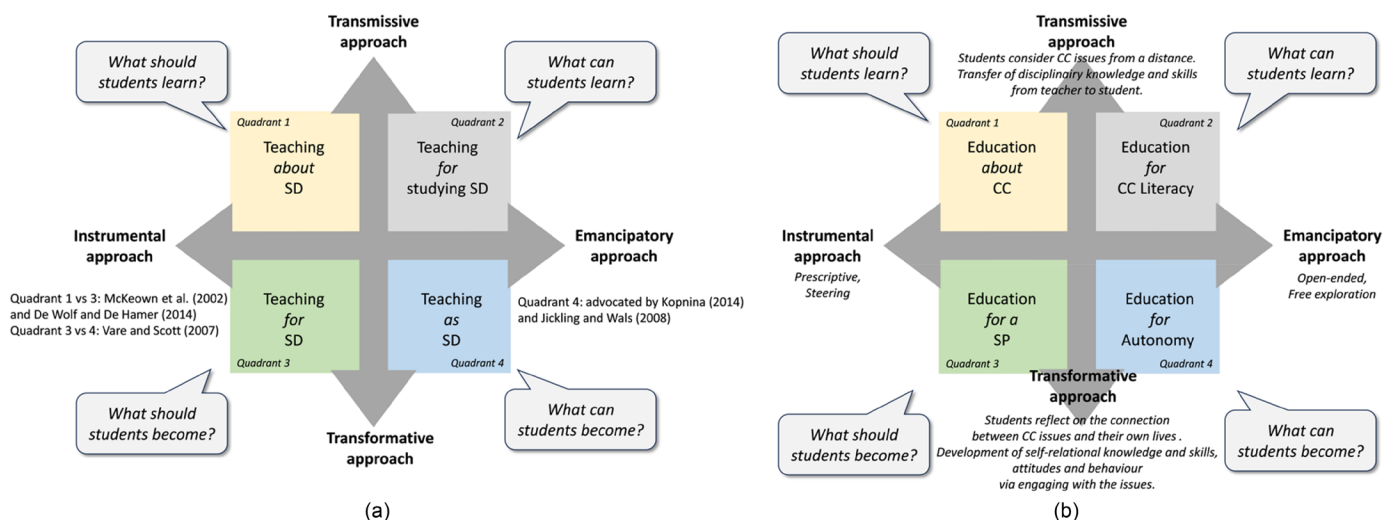


Figure 1. (A) The framework for approaches in sustainability education (adapted from Papenfuss et al. 2019). (B) The framework for approaches in CC education (Favier et al. 2024).

in college entrance examinations (MoE PRC 2017; Wang 2019). Given China's highly centralized and authoritative education system, it is likely that these structures also significantly influence how teachers address the global issue of CC in their classrooms.

The previous curriculum for secondary geography education was introduced in 2003. It primarily included standards related to the climate system, with one specific standard addressing CC: "Analyze the influence of global warming on human activities" (MoE PRC 2003, 8).

Regarding SD, students were expected to "Give examples of the intricate relationship between humans and the environment, explain the concept of SD, value sustainability, and feel responsible for sustainability development." Thus, the old curriculum appears to reflect the educational approaches of "education about CC" (Quadrant 1) and "education for a sustainable planet (SP)" (Quadrant 3).

The new geography curriculum was introduced in 2017 and includes standards for four key geographic competencies: (1) awareness of human-nature relations, (2) holistic thinking, (3) regional analysis and (4) geographic praxis (MoE PRC 2017).

Regarding the first competency, the document states: "Secondary geography education empowers students to enhance their understanding of the human-environmental relationships. This cultivates their key competencies, fostering a deep connection to their homeland and contributes to the development of a global perspective. It cultivates a sense of responsibility toward local, national and global geographic challenges and SD." This connects to a "education for a SP" (Quadrant 3) approach.

The new Chinese geography curriculum was influenced by education for SD principles promoted by UNESCO and other international organizations, most notably Agenda 21 and the United Nations Framework Convention on CC (Gong, Duan, and Guo 2021; Guo et al. 2022; Law 2014). These international policy documents served as guidelines for shaping national educational policies.

Table 1 presents all standards related to climate, CC and SD in the 2017 curriculum, illustrating their alignment with different approaches in the frameworks for sustainability and CC education (Figure 1A,B). Compared to the 2003 curriculum, the new curriculum introduces standards that go beyond mere knowledge and skills acquisition, incorporating elements that align with the "education for a SP" approach.

Since the late twentieth century, globalization has driven China and other countries to reform their educational institutions and curricula (Yates and Young 2010). In the updated standards, direct references to "climate change" in the 2003 curriculum have been reduced. Instead, the new standards categorize the causes of CC into components related to the climate system, emphasize global climate patterns and processes, and focus on greenhouse gas emissions.

This aligns with Shepardson et al. (2012), who identified five key areas of knowledge essential for CC education: natural causes and variations within the climate system; atmospheric dynamics and pollution; changes in snow and ice cover; oceanic factors, such as sea level, temperature, and marine life; soil and vegetation; and the impacts on human populations. Additionally, the new standards encourage teachers and textbooks to use CC as an important case study or project-based learning opportunity (MoE PRC 2017). Although sustainable values are part of the national geography standards, they are not assessed in national examinations. Additionally, approaches aligned with the "education for autonomy" framework are not present in the new curriculum.

4. Methodology

To explore the orientations of Chinese geography teachers, online semi-structured interviews were conducted with 15 geography teachers. Participants were informed about the procedures and provided consent at the start of the interview.

The interviews consisted of two parts (Appendix A and Figure 1). The first part gathered contextual information,

Table 1. Standards from the new 2017 curriculum regarding climates, CC and SD (MoE PRC 2017, 8–16), and interpretation using the four-quadrant framework (Figure 1).

Curriculum standards	Interpretation
Geography 1	
1.6 Use diagrams to explain concepts related to atmospheric heating and wind circulation	Education about climates
Geography 2	
2.9 Explain the causes and effects of pressing environmental issues and use principles about the harmonious coexistence of humans and the natural environment to pursue the ideals of sustainable development.	Education about SD Education for a SP
Optional model 1 Foundation of Physical Geography	
1.5 Use diagrams to illustrate the distribution of pressure zones and global atmospheric circulation, analyze their influence on climate patterns, and analyze the influence of climate in shaping physical landscapes and the influence on human activities.	Education for studying climates
1.7 Use maps about the global ocean circulation to analyze the impact of ocean currents on climate, and human activities.	Education for studying climates
1.8 Use visual representations to analyze the influence of atmosphere-ocean interactions on the global hydrothermal balance. Additionally, explain how phenomena like El Niño and La Niña effects weather patterns, wildfires, ecosystems, and economies across the globe.	Education for studying climates
1.9 Use diagrams and other resources to conduct an in-depth analysis of the principles of environmental integrity and differentiation.	Education for SD literacy
Optional model 2 Regional Development	
2.9 Illustrate the interconnection between regional sustainable development and global sustainable development using specific examples.	Teaching about SD
Optional model 3 Resources, Environment and National Security	
3.5 Apply knowledge about the carbon cycle and the greenhouse effect to analyze the consequences of carbon emissions on the environment. Elaborate on the importance of international collaboration to reduce carbon emissions.	Teaching about CC Education for a SP
3.8 Provide examples that showcase the interconnectedness of environmental protection policies and national security.	Teaching about SD

including the teacher's educational background, teaching experience, and the characteristics of their school and students. The second part involved a diamond ranking task, in which teachers ranked various learning goals and broader purposes of CC education and explained their preferences.

4.1. Participants

This study's participants were 15 secondary geography teachers from six provinces in China, with teaching experience ranging from three to six years. Participants were selected through the university of the first author's network.

The group included three male and twelve female teachers, reflecting the typical gender ratio among geography teachers in Chinese senior high schools. Eight participants were employed in key public senior high schools, while the remaining seven taught in regular senior high schools (Table 2).

4.2. Instruments

Diamond ranking tasks have gradually evolved into an established research method (Clark 2012). They are used to elicit constructs and foster in-depth discussion (Rockett and Percival 2002). Their strength lies in the premise that when participants rank items and explain their choices, they are encouraged to explicitly articulate the overarching relationships that structure their knowledge, providing valuable insight into their understanding.

The research approach in this study was inspired by Duindam et al. (submitted), who used a grading task to

investigate the perspectives of secondary geography teachers in the Netherlands on CC education. In their study, teachers were asked to grade several learning goals related to the "education about CC" and "education for SD" approach (Figure 1A).

In this study, we also included cards representing broader purposes, as well as cards related to two additional approaches within the framework for CC education: "education for CC literacy" and "education for autonomy." The diamond ranking task consisted of eleven cards featuring learning goals and purposes aligned with all four approaches to CC education (Figure 1 and Table 3).

Teachers were asked to arrange the cards (Table 3) within the diamond framework (Figure 2), placing the learning goal or purpose they considered most important at the top (Level 1) and the least important at the bottom (Level 5). They were then asked to explain their choices and describe their experiences teaching these learning goals. In contrast to Duindam et al. (submitted), who examined the ideal scenario in which teachers had full autonomy over their curriculum choices, this study focused on actual teaching practices and accounted for contextual factors such as curriculum constraints.

4.3. Data collection and analysis

Data were gathered through online interviews using Microsoft Teams between January and February 2023. Interview durations ranged from 30 to 60 min. All interviews were recorded and subsequently transcribed.

For data analysis, a quantitative approach was employed using a scoring system (Hopkins 2010). Each card was assigned a score based on its ranking: the top-ranked card received five points, followed by scores of four, three, two and one for subsequent levels. For every teacher, we calculated the average scores of learning goals and purposes within each quadrant.

The qualitative data were analyzed using NVIVO. First, the first author selected transcript excerpts that contained explanations for relatively high- and low-ranked card positions. Following grounded theory (Strauss and Corbin 1997) and beginning with open coding (Strauss and Corbin 1998), the first and second authors grouped similar explanations and generated codes for emerging categories.

The iterative process involved two rounds of test-coding, followed by discussions and adaptations of the coding scheme. In the final step of the analysis, we compared data across participants to identify patterns in high scores within quadrants and corresponding explanations.

5. Results

5.1. Preferences of geography teachers toward different CC learning goals and purposes

On average, participants ranked teaching goals and purposes associated with "education about CC" lower than those linked to the other three approaches: "education for CC literacy," "education for a SP" and "education for autonomy" (Table 4).

Table 2. Background of the respondents.

Name(fictive)	Gender	School type	Teaching experience	Educational background
Ray	male	Public Regular School	3 years	M.A. Geography Education
Yolanda	female	Public Key School	3 years	M.A. Geography Education
Emma	female	Public Regular School	3 years	M.A. Geography Education
Linda	female	Public Key School	4 years	M.A. Geography Education
Jane	female	Public Regular School	4 years	M.A. Geography Education
John	male	Public Key School	4 years	M.A. Geography Education
Fiona	female	Public Regular School	6 years	B.S. Geoscience
May	female	Public Key School	3 years	M.A. Geography Education
Rachel	female	Public Key School	5 years	M.A. Geography Education
Monica	female	Public Key School	5 years	M.A. Geography Education
Phoebe	female	Public Regular School	6 years	B.S. Geoscience
Diana	female	Public Key School	3 years	M.A. Geography Education
Bert	male	Public Regular School	4 years	M.A. Geography Education
Julia	female	Public Regular School	3 years	M.A. Geography Education
Janice	female	Public Regular School	3 years	M.A. Geography Education

Table 3. Cards used in the diamond ranking task. * = this card is part of two approaches: “education for a SP” and “education for autonomy,” as it is a prerequisite for respectively behavioral change and making well-considered decisions.

Cards		Connection to the framework (not shown to the teachers)
Learning goal	“Students can explain the causes and effects of CC”	Education about CC
Learning goal	“Students can explain national and international policy for mitigating CC”	
Purpose	“Students possess the core knowledge of CC”	Education for CC literacy
Learning goal	“Students can analyze maps and graphs about the causes and effects of CC”	
Learning goal	“Students can design a sustainable solution for an issue in a certain region”	Education for a SP
Purpose	“Students can critically study new information about CC”	
Learning goal	“Students can determine their own carbon footprint and the effects of CC on their own lives”*	Education for autonomy
Learning goal	“Students feel that mitigating CC is urgent and feel responsible to mitigate CC”	
Purpose	“Students contribute to sustainable change”	Education for autonomy
Learning goal	“Students can determine their own carbon footprint and the effects of CC on their own lives”*	
Learning goal	“Students can weigh sustainability of personal behaviors against pleasure and costs”	Education for autonomy
Purpose	“Students make well-considered choices in the personal lives”	

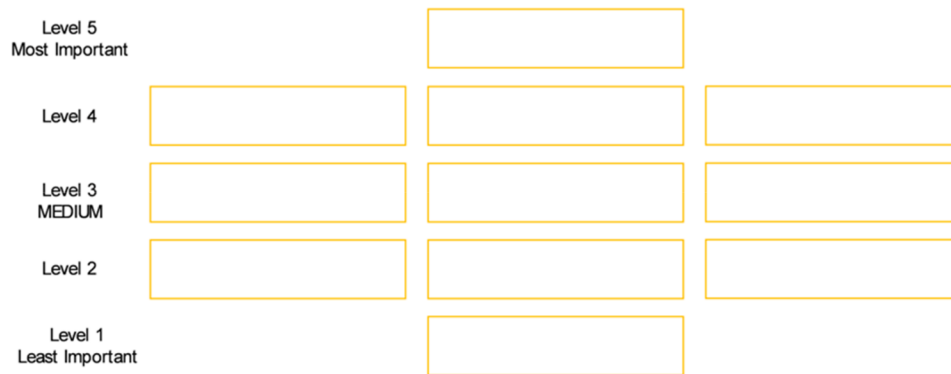


Figure 2. Diamond framework.

Table 4. Average ranking scores of the cards. * = this card is part of two approaches: “education for a SP” and “education for autonomy,” as it is a prerequisite for respectively behavioral change and making well-considered decisions.

Card	Average score per card	Quadrant	Average score per quadrant
“Students can explain the causes and effects of CC”	2.3	Education about CC	2.5
“Students can explain national and international policy and interconnections for mitigating CC”	2.8		
“Students possess the core knowledge of CC”	2.4	Education for CC literacy	3.1
“Students can analyze maps and graphs about the causes and effects of CC”	3.1		
“Students can design a sustainable solution for an issue in a certain region”	2.9	Education for a SP	3.2
“Students can critically study new information about CC”	3.3		
“Students can determine their own carbon footprint and the effects of CC on their own lives”*	3.0	Education for autonomy	3.2
“Students feel that mitigating CC is urgent and feel responsible to mitigate CC”	3.3		
“Students contribute to sustainable change”	3.3	Education for autonomy	3.2
“Students can determine their own carbon footprint and the effects of CC on their own lives”*	3.0		
“Students can weigh sustainability of personal behaviors against pleasure and costs”	3.1	Education for autonomy	3.2
“Students make well-considered choices in the personal lives”	3.3		

Interestingly, 14 teachers explicitly mentioned the pivotal role of knowledge when explaining their choices. Among them, 12 teachers emphasized that knowledge is a prerequisite for sustainable behavioral change, while six teachers argued that knowledge is necessary to raise awareness and transform attitudes. Hence, they regarded knowledge as a means to an end (conditional) rather than a goal in itself.

5.1.1. Position A: Preference for “education for CC literacy”

Phoebe, whose students were in their final year, demonstrated a clear preference for a pedagogy aligned with the “education for CC literacy” approach (Table 5). She referred to the curriculum, stating, “In their final year of high school, I prioritize meeting the exam requirement. Transmitting knowledge and skills is crucial.”

Phoebe focused on the cultivation of critical thinking, noting that it “was not explicitly mentioned until this year” in the college entrance examination outline. She regarded CC as an ideal context for fostering critical thinking skills: “For me, teaching isn’t solely about uncovering a single ‘correct’ answer. Instead, it is about encouraging students to think critically. This is especially necessary to analyze the impacts of CC, from various perspectives.”

5.1.2. Position B: Preference for “education for a SP”

Rachel was the only teacher who clearly prioritized learning goals and purposes associated with the “education for a SP” approach over other frameworks. She stated, “global climate change is a perfect case to achieve the standards for geographic

Table 5. Average scores per quadrant for each teacher.

Teacher	Education about CC	Education for CC literacy	Education for a SP	Education for autonomy	Position
Phoebe	2.7	4.0	2.7	3.0	A
Rachel	2.3	2.3	4.0	3.3	B
John	2.7	3.7	3.3	2.7	C
Ray	2.0	3.3	3.3	3.0	C
Linda	2.7	3.3	3.3	3.0	C
Fiona	4.0	3.7	2.0	2.3	D
Julia	3.3	3.7	2.3	2.7	D
Janice	3.3	3.7	3.0	2.3	D
Yolanda	2.3	3.7	2.7	3.3	E
Bert	2.0	3.3	2.7	3.7	E
Jane	1.7	3	3.7	3.7	F¹
May	2.0	2.3	4.0	3.7	F¹
Diana	2.0	2.3	4.0	3.7	F¹
Emma	2.0	2.3	3.7	4.0	F²
Monica	2.0	2.3	4.0	4.0	F²

key competencies as well as to cultivate responsible students who can contribute to a sustainable planet.”

She elaborated on her preference, explaining, “The pursuit of SD is the primary objective in secondary geography education, aligned with curriculum standards.” To illustrate this, Rachel described a project in which students engaged in local community service and place-based learning: “Students measure the school’s carbon emissions and devise reduction strategies, such as minimizing the use of electricity, enhancing greenery on campus, and reducing food waste.” She further reflected on the impact of this approach: “I was surprised—when I give them space and time to figure out solutions, they are very passionate and create such amazing results. Such an authentic experience is important to draw their own conclusions.”

In contrast to Phoebe and Rachel, the other 13 teachers demonstrated an inclination toward a fusion of two quadrants (Table 5 and Figure 3).

5.1.3. Position C: Preference for combining “education for CC literacy” and “education for a SP”

Ray, Linda and John favored learning goals and purposes associated with both the “education for CC literacy” and “education for a SP” approaches. Ray acknowledged his difficulty in prioritizing a single goal, stating, “struggling with prioritizing [is] the most important goal. Sustainability, it is a positive behavior or action. Students should analyze, determine, and translate sustainable behavior into practice. It relies on critically analysis.”

Linda emphasized the role of educators in fostering sustainability, explaining, “As educators, it is vital to nurture the younger generation’s understanding and commitment to sustainability by increasing awareness, developing critical thinking, and offering practical guide, to inspire students to become responsible global citizens who can contribute to a sustainable future.” The statements illustrate that the teachers viewed critical reflection on unsustainable practices as a prerequisite for sustainable behavioral change.

Additionally, Linda highlighted the importance of **geographic key competencies**, stating, “As responses to global climate change transcend national boundaries, it is important to develop students’ [key] geographic competencies in

awareness of human-nature relations, holistic thinking and regional analysis.”

Ray and Linda focused primarily on personal behavior and daily life choices, while John emphasized the need for professionals to address CC in rapidly developing countries: “In fast-growing countries such as China, it is crucial to have professionals who can preserve the environment and address CC. Therefore, it is very important to equip students with the necessary knowledge and thinking skills to address the issue.”

5.1.4. Position D: Preference for combining “education about CC” and “education for CC literacy”

Teachers Fiona, Julia and Janice favored learning goals and purposes associated with “education about CC” and “education for CC literacy,” both of which are considered transmissive approaches. Julia shared her evolving perspective on integrating knowledge and skills: “Initially, I thought that knowledge itself was not important, and that geographic thinking skills were more important. However, over past few years, I started to realize that basic knowledge is equally important. Only by applying acquired knowledge to explain the causes and impacts of CC can students construct their own knowledge framework and apply it to real-world challenges in the future.”

Julia stressed the importance of offering multiple perspectives instead of “teaching isolated and fixed knowledge.” All three teachers referred to the curriculum standards, which emphasize critical thinking skills. Julia argued: “CC affects regions differently. Some places become warmer, others colder. I encourage my students to think critically, to examine how the impacts of CC differ over time and space. I help them grasp the variety in effects.” She emphasized that it was “a necessary step to cultivate students’ geographic key competence of regional analysis.”

Fiona remarked, “Teachers are encouraged to capitalize on the extensive resources available on the internet to tailor their teaching methods and provide students with chances to develop skills in assessing information and cultivating logical and critical thinking.” She furthered explained, “The ability to gather information from different sources and tackle problems from multiple perspectives is crucial. This is why teaching resources shouldn’t be limited to textbooks alone.” Fiona added, “The use of maps and analysis of geographic information is important. It can be seen as the second language of

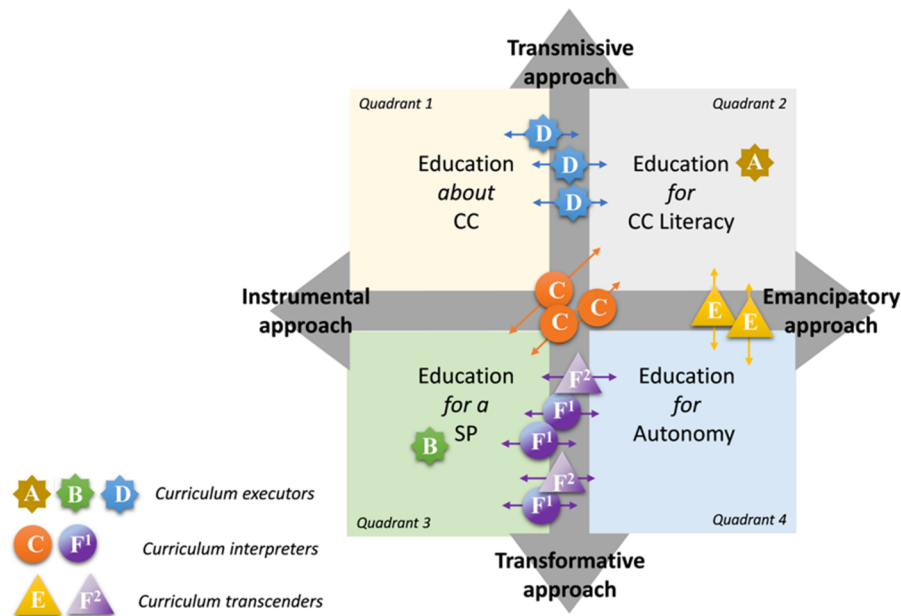


Figure 3. Positions of the fifteen interviewed Chinese geography teachers in the framework for CC education.

geography.” She also explained that this proficiency is valuable both in academic settings as well as in everyday life.

5.1.5. Position E: Preference for combining “education for CC literacy” and “education for autonomy”

Teachers Yolanda and Bert favored emancipatory learning goals and purposes. Yolanda explained: “Regardless of the path students choose, whether it aligns with sustainability or not, as long as they make a thoughtful decision, I am willing to support it. I inspire students to reflect on the concept of SD, and [help them] identify concrete actions such as low-carbon travel options and plant-based diets, that align with their values. It is essential to respect their autonomy and avoid being too prescriptive. We should refrain from exerting excessive influence on their choices.” Bert explained why she did not want to steer: “While the fact of global CC is certainly urgent, there are different viewpoints and controversies surrounding mitigation and adaptation.”

Both teachers emphasized the importance of critical thinking as a prerequisite for making informed decisions. Yolanda viewed critical thinking as essential, stating, “For students’ personal growth and future success, instead of simply telling them how to act, I give students abundant resources to show them that CC responses proposed by different countries and organizations often reflect the dominance of a particular viewpoint, but that doesn’t necessarily make [these responses] ‘the best.’ I refrain from passing judgment. I leave it to students to decide.” Bert expressed a concern, stating, “Students might rely excessively on authoritative information provided in textbooks, lacking the ability to think critically and independently.”

5.1.6. Position F¹: Balancing between “education for a SP” and “education for autonomy”

The combination of “education for a SP” and “education for autonomy” accounted for the largest share of teachers. Within

this group, we identified two subcategories based on the underlying considerations expressed by the teachers.

Teachers Jane, May and Diana agreed on the importance of promoting sustainable behavior but emphasized the need to consider social contextual factors that may act as barriers to sustainable behavioral change. Therefore, they wanted students to explore which sustainable behaviors were realistically feasible for them. For instance, Diana regarded stimulating SD as “a prominent goal throughout the geography curriculum. It is vital to encourage students to develop a sense of agency and commitment toward addressing CC.” However, she acknowledged, “Due to realistic conditions and the position of students in society, their options are often restricted. Honestly, they deal with substantial educational pressure and tight school schedules, while many sustainable actions can be time-consuming and costly. Aiming to contribute to SD in their daily lives can be quite challenging.”

5.1.7. Position F²: The midway position between “education for a SP” and “education for autonomy”

Teachers Monica and Emma viewed sustainable behavioral changes as a desirable outcome but did not want to directly steer students toward behavioral change. Instead, they wanted to inspire students by providing incentives while respecting their autonomy.

For example, Monica elaborated on the importance of “awaking students’ values and principles and translating them into personal actions” but stressed, “Students have the right to make their own choices.” She further explained: “My goal is not to judge them based on my own beliefs or values. Instead, I hope they can consider multiple perspectives and factors when making decisions and take the broader geographic context into account. By giving hidden clues and emphasizing their significance, we can help students recognize the interconnectedness of different environmental issues and develop a more comprehensive understanding of the

challenges our planet is facing. The results are open-ended, not necessarily always positive [for SD], as it depends on their own judgment and understanding.” Similarly, Emma stated, “I do not impose on students to contribute to SD. They do not like to be pushed or told to ... I choose to encourage them to become voluntary participants and advocates of the global future. I mean, I advise instead of coerce.”

5.1.8. Objections to CC learning goals and purposes

The previous sections discussed the positions of teachers based on their preferred learning goals and purposes, as well as the underlying beliefs that informed their perspectives. However, it is also interesting to look at learning goals that received low scores.

Teachers Phoebe, Julia, Janice and Ray assigned low scores to learning goals connected to transformative objectives. A frequently cited objection to focusing on sustainable behavior was the limitations imposed by social contextual factors, such as time constraints and additional costs associated with sustainable options. Besides this, teachers acknowledged that parents play a significant role in shaping students' daily-life choices. For example, May noted, “When discussing daily-life choices, we also mentioned vegetarianism. However, this involves not just health considerations, but also religious beliefs and family traditions. I mean, parents largely determine students' choices.” Similarly, several teachers were cautious about disrupting the parent-student relationship. Monica explained, “I guide students toward understanding the benefits of vegetarianism for health and the environment. I suggest simple vegetarian recipes and menus. But they are just suggestions. I try not to push them. It may cause opposition from their parents.”

May further elaborated, stating, “For some sustainable choices, such as plant-based diet, I must be careful, as parents may not agree. Parents may feel that their children need meat [because they are still in the growing phase]. So, this may cause a lot of trouble in their families.”

Beyond these concerns, Ray questioned the effectiveness of education focused on sustainable behavioral change, explaining, “Even if education promotes [sustainable behavior], it may not be 100% effective... because some studies have shown that although children understand what they can do or [think about] what they want to do, they actually won't do it. There is a gap between 'knowing what [to do]' and 'how to do it.'”

5.2. Orientations toward the new curriculum

We also investigated how teachers connected their preferences for specific learning goals and purposes to the curriculum, and thereby determined their orientations toward the new curriculum. Through data analysis, we identified three distinct orientations: curriculum executors, curriculum interpreters and curriculum transmitters. These positions represent different ways teachers respond to the key competencies-oriented curriculum. Although teachers are required to implement the curriculum standards, they now have greater flexibility than before to pursue their own educational

objectives. This allows them to prepare students for their future, rather than focusing solely on preparing them for national examinations.

5.2.1. Curriculum executors

Despite being positioned in different quadrants, teachers Phoebe (Position A), Rachel (Position B) and Fiona, Julia and Janice (Position D) all underlined the importance of executing the national geography standards. Teachers Phoebe, Fiona, Julia and Janice, who taught in regular schools, viewed the curriculum as something they simply *must* follow. They focused on transmitting textbook content to their students and described how the curriculum standards functioned as a contextual authority shaping their pedagogical decisions. For example, Julia stated that the college-entrance examination acts as a “baton” for teachers, pushing them to prepare students for exam success. This reflects the implicit consequence that the dominance of national examinations dictates choices throughout the system (Ruoling 2010).

Although Phoebe, Fiona, Julia and Janice practiced transmissive approaches, Fiona added that “CC education can inspire students to value human-environment relationships, which is in line with the fundamental task of moral education, one of main purposes of the curriculum reform.” While Fiona valued awareness and sustainable behavior, she still prioritized knowledge and skills, as these are assessed in national exams. In this sense, their teaching primarily instills the preferred knowledge, message, agenda and ideology, which are set by the central government, educational institutions and other curriculum stakeholders.

In contrast, Rachel placed significant emphasis on sustainable attitudes and behavior because they were included in the curriculum, even though they were not assessed in national exams. She described a project in which students investigated ways to reduce the school's carbon footprint “in line with national policies on carbon neutrality.”

5.2.2. Curriculum interpreters

In contrast to the curriculum executors, teachers John, Ray and Linda (Position C) and Jane, May and Jian (Position F¹) took pride in the fact that their personal commitment to SD aligned with the new geography curriculum. They felt supported by curriculum standards that emphasized sustainable values and behaviors, using these elements to substantiate their teaching choices.

All six teachers stressed the importance of global competencies and referred to the vision document that formed the basis of the new national geography standards (MoE PRC 2014). Teachers Ray, Linda, May and Diana connected CC education to the idea that “we share a common future.” May expressed that her personal beliefs “lie more in the consciousness of global understanding, since no human is an island. Educating the future generation of citizens is of utmost importance.”

Diana emphasized the unique role of geography education, stating, “Our school subject is highly suitable for achieving the goals of future-oriented global education. We geography teachers must take on this responsibility. There are hardly any other disciplines that can handle it.”

Linda highlighted China's significant initiatives and accomplishments in sustainable change, stating that she was "dedicated to fostering a profound sense of pride among students and nurturing their active involvement and deep connection with the issue."

5.2.3. Curriculum transcendence

Participants Yolanda and Bert (Position E) and Emma and Monica (Position F2) did not explicitly express support for or objections against the new curriculum. However, they emphasized a desire for more flexibility to pursue their own teaching approaches and educational goals. For instance, Yolanda supported her school's obviously distinct approach, stating, "We do not excessively emphasize the specific knowledge required for exams. Instead, our [school's] approach is to broaden students' perspectives. It is important to keep the 'freshness' of the geography that I teach, which makes me happy to teach and students happy to learn. I mean, it enables us to better teach and convey the essence of geography as a school subject. Shifting away from a sole focus on [national exam] scores, we want to fully promote and facilitate the development of students' geographical thinking and key competencies."

Similarly, Emma emphasized that "critical thinking and scientific literacy" benefit both students' "short-term academic success" and "shape their long-term development perspectives." She wanted her students to be critical about the information in official textbooks, explaining, "The critical analysis of available information contributes to informed decision-making. Screening information sources and critically evaluating the objectivity of the data shown in official textbooks."

Since these teachers also valued open-ended, transformative learning goals that were not explicitly mentioned in the curriculum, they can be classified as "curriculum transcendence." Like curriculum interpreters, they also discussed the importance of cultivating global competencies. Bert noted, "Geography has the potential to cultivate students' global competence by providing them a broader perspective."

Both Monica and Emma openly acknowledged the importance of preparing students to think globally when addressing the complexity of CC. Monica described CC as "a complex issue that cannot be addressed by a single person or country alone and requires global cooperation and action." Therefore, Monica articulated her goal of "trying to cultivate active changers who are not only aware, but also be empowered to make a difference, make change, and promote that sort of autonomy."

6. Discussion

The theoretical framework outlining different approaches to CC education (Figure 1) proved to be applicable for studying the orientations of the Chinese secondary geography teachers interviewed in this study. Our findings revealed that most teachers combined approaches across two quadrants, indicating a multidimensional focus. This aligns with research by Favier et al. (2024), which showed that

geography teachers in the Netherlands also exhibited multiple orientations toward CC education.

Although orientation is typically understood as comprising beliefs about the purposes and goals of education and beliefs about effective teacher-student interactions (Friedrichsen, Driel, and Abell 2011), we argue that positions toward the curriculum should also be included in this definition. During the interviews, teachers frequently referred to the curriculum—often unprompted—and did so in different ways, reflecting varying degrees of alignment and interpretation.

On one hand, the Chinese national geography curriculum strictly defines what must be taught, particularly in the domains of knowledge and skills. Teachers are not entirely free to determine their teaching practices, as they experience pressure from schools and broader educational cultures (Brooks 2016).

On the other hand, this study showed that within these constraints, Chinese teachers maintain diverse interpretations of CC education. Five teachers adhered closely to the curriculum, explaining that their teaching practices were shaped by national policies. Six teachers selectively incorporated curriculum elements to align with their personal preferences. Among these teachers, Julia acknowledged the presence of "the authoritarian and hierarchical view of social interaction," which Jickling and Wals (2008) refer to as "Big Brother sustainable development"—where authorities dictate the "correct" course of action, and education serves to implement this predetermined outline.

Meanwhile, four teachers transcended the curriculum, favoring transformative-emancipatory approaches that match more with Western liberal democratic principles (Cross and Congreve 2021; Monroe et al. 2019) than Chinese Confucianist values.

In our study, critical thinking was frequently mentioned by the interviewed teachers, though they used the term in different ways. Phoebe, Fiona, Julia and Janice (Positions A and D) used "critical thinking" to refer to analyzing CC issues, in the sense of "being critical that the impact of CC varies per region" and "being critical that there are different perspectives on the issue." These teachers emphasized that critical thinking skills are important for performing well in national exams.

In contrast, John, Ray and Linda (Position C) viewed critical thinking as the ability to critically assess current unsustainable practices to evoke concern and stimulate behavioral change. Meanwhile, Yolanda and Bert (Position E) advocated for promoting critical thinking in media literacy. For instance, Ray highlighted the importance of "letting students critically reflect on the reliability of information sources about CC in the media." Both teachers emphasized the importance of empowering students to challenge prevailing notions of climate-friendliness and to critically question authorities.

Despite China's government advocating for "carbon reduction targets," in which citizens are called to reduce their carbon footprint, eight teachers found it challenging to promote climate-friendly behaviors. Several teachers acknowledged that living an eco-friendly lifestyle can be more expensive

than a conventional one, making it less accessible to some students. This aligns with research showing that while individuals may support climate-friendly practices, they are often hesitant to alter their own consumption habits or lifestyles (Ratinen 2013). Neglecting differences in socio-economic status and capabilities when promoting climate-friendly consumption is considered unjust (Evans, Welch, and Swaffield 2017).

Other teachers found it challenging to encourage students to adopt climate-friendly choices, such as eating more vegetarian food, because they did not want to interfere with parental authority or cause disputes between children and their parents. This reluctance is characteristic of the Confucian tradition in Chinese society, where students are expected to obey their parents. In such a context, it is crucial to consider whether students are genuinely given opportunities to engage in CC mitigation actions (Tolppanen et al. 2017). Some researchers advocate for intergenerational learning (Liu and Kaplan 2006), in which students encourage their parents to adopt more sustainable behaviors. However, such approaches would likely face resistance among Chinese educators.

Research by Favier et al. (2024) and Duindam et al. (submitted) on geography teachers in the Netherlands showed that the majority of teachers strongly opposed the “education for a SP” approach. They believed that education should not overly promote a single set of values and behaviors and that teachers should remain neutral.

This objection was also mentioned by two of the Chinese teachers interviewed in this study, both in Position E. Thus, it seems that while beliefs about the importance of educational neutrality appear to be less dominant in China, they are not entirely absent.

Compared with research conducted in other countries, such as the Netherlands, Finland, Singapore and Botswana, it is notable that some Chinese geography teachers aimed to instill pride in China’s achievements in addressing global CC. They sought to cultivate a sense of community and responsibility, encouraging students to contribute to a sustainable planet.

This aligns with the ongoing tension in China’s curriculum reform between globalization and nationalism: while students are prepared to compete globally, there is also an emphasis on fostering national pride and encouraging them to identify with and take pride in China’s achievements (Law 2014).

Our research suggests that curriculum context, along with social-cultural, economic and political factors, influences what and how teacher teach CC. This influence cannot be overlooked and warrants further investigation. We hope that our research offers valuable insights that may also be transferable to other countries. Context—both local and national—is crucial. This implies that the “education for a SP” framework promoted by UNESCO and other international organizations may be implemented differently across various nations.

Additionally, our research indicates that some teachers struggle to balance their personal objectives of cultivating sustainable behavior or well-considered behavior with the

pressures of national examinations. This challenge is not unique to China (Chang, Pascua, and Ess 2018; Favier et al. 2024). It would therefore be valuable to conduct similar research in other countries to further explore how national context influence teachers’ orientations toward CC education. Although the number of participants in our study was limited—especially considering the size of China’s population—our findings demonstrate that the four-quadrant framework is a useful tool for investigating teachers’ orientations toward CC education.

7. Conclusion

In this study, we asked 15 Chinese geography teachers to rank learning goals and purposes associated with four different approaches to CC education. The data revealed that teachers ranked learning goals connected to the “education about CC” approach lower than those in the other approaches, such as “education for CC literacy,” “education for a SP” and “Education for Autonomy.” However, many agreed that knowledge serves as an essential foundation for constructing a personal knowledge framework.

However, there were considerable differences among the teachers. Only two teachers had a clear preference for a single approach: one favored “education for CC literacy,” while the other preferred “education for a SP” approach. The remaining 13 teachers combined two different approaches. Five teachers sought to execute the curriculum, aligning with “education about CC,” “education for CC literacy” as well as “education for a SP.” Six teachers used the curriculum selectively to support their position, while four teachers sought to go beyond the curriculum, embracing a more emancipatory “education for autonomy” approach.

Compared to previous research in Europe and North America, we observed less emphasis on educational neutrality but identified factors unique to the Chinese context—such as the promotion of national pride and respect for parental authority. These findings highlight the critical role of society in shaping how and what teachers teach about CC.

Finally, we emphasize the importance of amplifying the voices of thoughtful and empathetic educators, like our participants, who stand at the frontlines of preparing students for complex futures. At the end of our interviews, nearly all participants expressed gratitude. One teacher shared: “Thank you for providing me the platform to articulate my ideas. This process helped me review and reorganize my teaching goals, emphasizing the importance of my work.” We argue that teachers should have more opportunities to express their perspectives on sustainability education, making the “invisible” voices of educators more visible.

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Appendix: Semi-structured interview questions

The following semi-structured interview questions were designed to explore teachers' backgrounds, perspectives on climate change education, and decision-making processes in their teaching practices.

Background Information

- What is your educational background?
- How many years of teaching experience do you have?
- What grade level(s) do you currently teach?
- What are your main concerns regarding global climate change?

Questions about CC education

- How do you define the climate change education?
- To what extent are your content choices and teaching decisions regarding climate change education supported or constrained? Consider influences such as the national curriculum, school environment, and relationships with students or parents.
- How do you think these factors impact student learning and engagement?

Questions on the card ranking task

- For each card: Please explain the reason why you place this card here.
- **Final Reflection** Is there anything else you would like to add or discuss?