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TEACHING CLIMATE CONTROVERSY
US Teachers' Views, Feelings, and Preparedness Towards
Teaching Climate Change

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ABSTRACT

Janice Johnson: Teaching climate controversy, US teachers' views, feelings, and preparedness towards teaching climate change

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Climate change is one of the most troubling realities of our time, yet it is still considered to be a decisive issue to some in the United States. For this reason, climate change education is not always comprehensive in US classrooms and included in curricular standards. The present study explores teachers' views, feelings, and preparedness towards teaching climate change and the controversial aspects of it. A thematic analysis of semi-structured interviews (N=7) revealed that teachers in the study did not view climate change as controversial and instead viewed discourse on the subject as way enhance students' critical thinking and active citizenship. Furthermore, teachers revealed obstacles related to parental infringement and overt pressure from stakeholders pose challenges towards teaching climate change. Finally, because of missing or altered curriculum standards and a shortage of explicit formal training on climate science and pedagogies, teachers disclosed their lack of feeling of preparedness to teach climate change. These findings reinforce existing literature by providing insight into how teachers' experiences influence the teaching of climate education is and suggest measures to improve the approach to teaching climate change in US classrooms through curricular reform and pedagogical practices.

Keywords: Climate change education, teacher, views, feelings, preparedness, controversy

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INTRODUCTION - NAVIGATING CONTROVERSY: CLIMATE CHANGE EDUCATION IN THE UNITED STATES

Climate change is arguably one of the most troubling challenges of our time (OECD, 2019). Yet, in the United States of America, climate change continues to be considered a controversial cultural, personal, political, and economic topic (Hulme, 2009). Changing climates around the globe have direct impacts on the livelihoods of populations, food supplies, natural disaster occurrence, infectious diseases, and much more (Hayhoe et al., 2018). Recent years have been eye-opening in regard to extreme weather events worldwide. Troubling heatwaves, excessive droughts, wildfires, floods, hurricanes, and emerging infectious diseases occur more frequently as a result of climate change (Hayhoe et al., 2018).

Climate disasters are becoming the norm for people living in most regions of the world, yet even some of those affected by climate change disasters continue to deny that climate change is human induced (Sloggy et al., 2021). According to a 2021 analysis of by the Center for American Progress Action Fund, 139 members of 117th US Congress which includes both House of Representative and Senate Members from 3 January 2021 – 3 January 2023 deny or cast doubt on the scientific consensus that that world is warming and that climate change is human induced, all of which are representing the Republican party (Drennen & Hardin, 2023). These are the individuals who possess the power to create, change, and pass federal legislative action towards climate change policy and education, which paints a clear picture as to why there are no federal and nationwide climate change educational standards in the United States (Dunlap & McCright, 2008). Climate change is considered a controversial

topic in the United States because individuals, policymakers, and governance protocols cannot agree on the urgency in which climate change needs to be addressed nor to which degree it needs to be mitigated (Hulme, 2009).

Additionally, the idea that humans possess different core beliefs and values plays a role in the economic strength governing climate action as well as the consideration of the needs of future generations (Hulme, 2009). When it is difficult to come to a consensus on a fundamental understanding of a topic, it becomes controversial, emotionally charged, and therefore uncomfortable to discuss, which poses pedagogical challenges for educators to teach it in a school setting (Council of Europe, 2023; Flensner, 2020). Considering that education in the United States is governed both nationally and locally, the political ideals of the community play an important role in the way educational standards and curriculum are developed. Policymakers often cannot agree on several aspects of climate change so it remains a controversy in the day to day lives of individuals as well, which then affects the way it is taught in schools (Hannah & Rhubarb, 2019).

The purpose and significance of this research is gaining a deeper understanding of teachers' views and feelings towards teaching climate change education in some US classrooms as well as to gain insight into their feelings of preparedness to teaching climate change education. In this study, I will specifically focus on climate change as the subject of teaching controversy and how teachers feel about teaching climate change and the sometimes contentious nature of the topic in the classroom. I aim to gain a deeper understanding of teachers' views, feelings, and preparedness to addressing uncomfortable, emotional, and controversial issues that are not always easy to discuss. In order to explore these topics in more in depth, the following research questions are employed in this study include:

(Q1) What are teachers' views and feelings about teaching climate change?

(Q2) How prepared do teachers feel to teach climate change?

As our world becomes increasingly more connected virtually, discourse on differing opinions is crucial to effective communication and learning (Santos et

al., 2017). Teachers can play an active role in activating students' confidence to approach uncomfortable conversations that are necessary to survive in today's world both socially, economically, and personally (Woolley & Fishbach, 2022). Engaging in uncomfortable discourse in educational settings can result in increased coping skills, motivated self-growth, and increased engagement in uncomfortable situations, emotions, and feelings (Woolley & Fishbach, 2022). With this information, teaching controversy and engaging in uncomfortable discourse in the classroom can act as a powerful tool not only for supporting students' growth at school, but personal growth in everyday life, and social interactions both in person and online (Boler, 1999).

1 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This section will cover the key concepts: *controversial topics, climate change education, teachers' views and feelings, and teachers' preparedness towards teaching climate change*. In this chapter I will further explore theory and previous literature related to climate change education and teaching controversial topics in the classroom.

1.1 Defining Controversial Issues

Almost any topic can be considered controversial so long as people hold different beliefs and there is no universally held viewpoint, however, a controversial issue “must be addressed through means of reasoned and informed reflection, debate and evaluation” (Woolley, 2010, p.2). Controversial issues contain opinions that deviate from the normative opinions within a specific group (Lennon, 2022). They arouse strong feelings and emotions and can be difficult to discuss in a rational manner (Council of Europe, 2024; Flensner, 2020). Controversial topics contain both facts and opinions and have the ability to teach those discussing them to deal with differing perspectives and disagreements which is essential to the continuation of democracy in our ever-growing polarized world (Flensner, 2020). Controversial issues can be both local and global as well as vary from place to place (Council of Europe, 2024). Some examples of controversial issues include abortion, immigration, race, gender identity vaccines and most notably for this study climate change. In a study involving seven schools and 12 participating teachers in Sweden, Flensner (2020) unveiled how teachers found some issues more controversial than others and these teachers found some issues not to be controversial at all. Teachers in this study felt that any issue pertaining to human rights should not be controversial because it deals with human lives and that itself

is not controversial. However, the unfortunate reality is many controversial issues are intertwined with human existence and sustenance.

Many topics may be considered controversial in nature due to the way in which they challenge the status quo, they may be a political decision (and politics are debatable and controversial, especially in democratic societies), or they may simply be ideas that make us feel uncomfortable (Woolley, 2010). Controversy and controversial issues surface in our day-to-day lives and are almost unavoidable, which leads us to dig deeper into the importance of teaching controversial topics in educational settings.

1.1.1 Why is it important to teach controversial topics?

Controversial topics may not always be at the top of teachers', students', parents', and administrators' list of matters to teach due to their emotive and potentially volatile nature, however, in an ever-widening polarized world, learning to reflect upon, critically analyze, and diplomatically discuss these issues is of utmost importance (Chen & Cui, 2022; Flensner, 2020; Lennon, 2008; Woolley, 2010). According to the OECD (2022), the role of education is to provide students with the tools they need to think, evaluate, and reflect so they can develop lifelong skills, values and tools to foster personal growth and contribute to societal progress. It is important for teachers to teach students not only what controversial issues are, but more importantly to create a dialogue around them so in turn schools can “promote freedom of expression as well as inclusion, tolerance and human rights and prevent or counter, the use of hate speech by students” (Council of Europe, 2024).

Dialogue is not only an important cornerstone of democracy, but it also constructs knowledge (Nieto Ángel et al., 2020). Giving students a safe place to discuss sensitive and controversial topics supports students in developing both critical and empathetic thinking which supports having open and reciprocal dialogue and opens the door to understanding new concepts (Hess, 2002; Lennon, 2008; Nieto Ángel et al., 2020). The aim of open dialogue is for each person involved to feel confident enough to speak and share their thoughts through the participation of active listening, critical evaluation, and most notably respect (Nieto Ángel et al., 2020). When discussing controversial topics in

educational settings, teachers often discourage the use of persuasion techniques with the aim of changing other minds, likewise, students do not have to agree, they are simply encouraged to share their opinions and learn from the opinions of others (Hess, 2002; Kuş, 2019; Nieto Ángel et al., 2020).

Furthermore, open dialogue helps address different degrees of polarization. Polarization often leads to increased division and hostility with an “us versus them” mentality which results in reduced empathy and hinders constructive dialogue because decisiveness is fueled in the post-truth era in how truth is not open for debate (Nieto Ángel et al., 2020). Giving students space to discuss sensitive topics in schools teaches students the difference between opinions and truth and challenges students to critically reflect upon their own knowledge and preexisting biases (Boler, 1999).

Previous research indicates that teachers are not only willing to but eager to teach controversial issues at schools and feel that it is important for students to have a safe place to discuss issues and share and express their opinions (Chen and Cui, 2022; Flensner, 2020; Kuş, 2019). Teachers aim to facilitate discussion on controversial public issues as a means to enhance critical thinking, content knowledge, and interpersonal communication skills (Hess, 2002). When discussing controversial public issues in school, teachers often feel most comfortable teaching those which are already included in the curriculum and have students prepare for debates by reading preselected material from the teachers so students come to class prepared for the discussion (Hess, 2002; Kuş, 2019). By reading preselected reliable material preceding the discussion, students learn critical literacy in the age of disinformation and may be more willing to participate in the conversation if they have prior foundational knowledge on a topic (UNESCO, 2023).

In some cases, teachers may not want to teach controversial issues as they fear it could pose harm to their job security if they said or did the wrong thing around teaching the issue (Lennon & Russell, 2008). Regardless of whether teachers want to teach these issues at school or not, teachers report an unwillingness to share their personal opinions on these sensitive subjects and maintain a neutral stance during discussions and debates (Chen & Cui, 2022; Flensner, 2020; Kuş, 2019; Lennon & Russell, 2008). By remaining neutral teachers feel that students are more willing to discuss their own personal opinions

amongst each other in an even-handed manner without fear of disagreeing with their teacher and risking their grade for that course (Hess, 2002; Kuş, 2019). Teachers often disregard comments that may come off as politically incorrect or volatile because the purpose of teaching controversial public issues in classrooms is to enhance students' interpersonal skills related to communication, collaboration, empathy, conflict resolution, teamwork, and active listening which are all skills that contribute to progressive personal and professional relationships especially later in life as students enter the workforce (Flensner, 2020; Koenig, 2011).

1.1.2 Why is climate change a controversial topic?

The decisive nature of climate change in the United States stems from the diversity of core beliefs and values among people, influencing both the economic approach to climate action and the consideration of the needs of future generations (Hulme, 2009). Furthermore, there is a lack of consensus among individuals, policymakers, and governance protocols regarding the urgency and extent to which climate change needs to be addressed (Hulme, 2009). It is crucial to clarify that climate change is not a controversy among scientists who study climate and the environment, there is a clear agreement that climate change is happening and is anthropogenic, or human-caused, by the scientific community (IPCC, 2023). The controversy of climate change lies among individuals, communities, religious groups, schools, lobbyists, the food industry, the car industry, policymakers, and most importantly economics and politics (Hulme, 2009; Worth, 2021).

Up to date, reliable information on climate change from scientists is readily available through but not limited to reports on the Intergovernmental Panel on Climate Change (IPCC), United Nations Environment Programme, National Center for Atmospheric Research (National Science Foundation), and the National Centers for Environmental Information (NOAA) however, this information may not be received well or known by the general public (Intergovernmental Panel on Climate Change, 2024; National Center for Atmospheric Research, 2024; National Center for Environmental Information, 2024; UN Environment Programme, 2024). It is most common for individuals to

receive information on climate change from news outlets and social media platforms (Boykoff, 2007; Treen et al., 2020). News outlets continue to fail to accurately report the anthropogenic nature of climate change, which can cause climate confusion amongst those consuming such media and this confusion is a contributing puzzle piece to the climate debate (Boykoff, 2007).

Furthermore, it has become ever more prevalent that social media platforms play a role in the spread of misinformation (Treen et al., 2020). Not only can social media perpetuate confirmation bias, but the idea of an algorithm bias, or that the most engaging and popular content is being promoted online regardless of its validity or trustworthiness, can greatly enhance the spread of misinformation, particularly when individuals lack critical media and digital literacy skills (Treen et al., 2020). Lack of information, knowledge, and misinformation are factors that contribute to confusion over whether climate change is human-caused, and therefore contribute to why climate change continues to be a controversial issue in the United States (Foss & Ko, 2019; Lombardi & Sinatra, 2012; Khalidi & Ramsey, 2020; Treen et al., 2020).

The proposal that climate change is a belief system, and belief systems are the foundation for an individual's truth and personal convictions can lead to misunderstandings and conflicts when belief systems clash (Bhagwat et al., 2016). According to the United Nations (2024), the causes of climate change are generating power, manufacturing goods, cutting down forests, using transportation, producing food, powering buildings, and consuming too much. Under each of these causes presented by the UN, there are a lot of beliefs and ideologies related to lifestyle, personal, potentially religious, cultural, and societal choices. For example, some individuals may choose to eat a vegetarian diet because they understand that cutting down forests to create farms or pastures (United Nations, 2024) contributes to CO₂ emissions, however, others may not believe in eating a vegetarian diet and choose to believe that eating meat is not a contributing factor to climate change because if they did, that would mean they need to change their lifestyle and actions, ultimately their belief system (Bhagwat et al., 2016). Additionally, when climate change is discussed as a belief system rather than a scientific fact, misconceptions around it are likely to spread, particularly on social media, especially amongst those who already deny that it is happening or that it is human caused (Treen et al., 2020).

1.1.3 Why is climate change a politically charged issue?

The other and most important belief system that is at the core of the climate controversy in the United States is the political ideologies engrained in the climate discussion chiefly “because of the far-reaching implications of policy interventions that are often advocated in response to the phenomenon” (Hulme, 2020, p.1). Americans continue to debate on whether actions to slow down or mitigate climate change should be intervened at a national scale or if they should be solved at a local or individual level (Dunlap & McCright, 2008).

While there is diversity in opinion, Republican policy makers in the US generally do not advocate for regulatory measures in mitigating climate change (i.e. cutting emissions, reducing consumption, decreasing oil drilling, etc.) (Dunlap & McCright, 2008). Additionally, those with conservative encompassing values do not believe the government should intervene with day-to-day choices related to the environment nor do they want their tax money spent on mitigating an idea that they believe may or may not be a pressing issue (Dunlap & Jacques, 2013). Democratic policy makers tend to advocate for the United States to take part in the United Nations Framework Convention on Climate Change (UNFCCC) as well as take actions collectively as a nation to reduce emissions (Sanford et al., 2019). Since the United States is a two-party political system and beliefs tend to belong to one party or the other when related to economic concerns and individual freedoms, many issues become controversial partially due to political party elites perpetuating polarization and due to the issue of Americans continuing to choose party over policy (Boven et al., 2019; Dunlap & McCright, 2008).

A psychological study by Boven et al. (2018) involving 2121 participants in September 2014 and October – November 2016 demonstrates that although individuals from the general public believe in climate change and its anthropogenic nature regardless of political affiliation, (although democrats did report a greater urgency to address climate change), democrats and republicans do not agree with each other which contributes to the partisan divide in US politics on climate change. Political elites speak loudly on their climate change views as they feel that is what their supporters want, however, individuals choose to support their political party over political agenda, and therefore the political

controversy of climate change is more of an issue of democrats and republican's clashing on policy rather than climate change itself (Boven et al., 2018).

One final piece of the climate controversy lies in the idea that climate change is inexplicitly complex embedded with multifactorial ethical and moral political questions beyond the day-to-day scope which often puts individuals in an interpersonal deadlock (Hulme, 2020). This makes it easier to allocate power to political elites to make decisions on how climate change is mitigated, when in fact Hulme (2020) suggests the complete opposite – that the solution to climate change involves grassroots movements from individuals and local communities. With an issue as large scale and intricate as climate change on the table, it is often challenging for individuals to understand why and how to make change and the importance of those actions.

1.2 Climate Change Education in the USA

Climate change education “helps people understand and address the impacts of the climate crisis, empowering them with the knowledge, skills, values, and attitudes needed to act as agents of change” (UNESCO, 2022). Climate change education in the United States is widespread, yet still ambiguous and, in some cases, even non-existent.

It is important to note that much of what is taught around climate change stems from environmental education and focuses on climate change from a scientific perspective in which teachers teach that there is a consensus in the scientific community that climate change is a phenomenon, but do not always engage in the idea that climate change is considered a controversial issue and why it is considered to be so (United States Environmental Protection Agency, 2022). Environmental education is often a focus point when educating students about the environment and it takes on the approach of learning about problems in the environment, critically engaging in issues regarding our natural world, and taking action or making change for a better future (United States Environmental Protection Agency, 2022). Environmental education provides a foundational understanding of climate change from a scientific standpoint; however, comprehensive climate change education needs to be taught in order for students to gain an understanding of the urgency of the climate crisis. Furthermore, it is

crucial for climate change education to address its controversial nature, paving way for discussions from personal and policy perspectives (Nation & Feldmann, 2022).

1.2.1 Common Core Standards (CCSS)

Curriculum in the United States is wide, and universal educational standards and learning do not exist regardless of initiatives, policies, and laws aimed at doing so. Up until this day, there are no national education standards that apply to every state, district, and public school. Each state mandates which curriculum and standards will be taught at public schools and although school funding in the US is a combination of local, and state, 93% of K-12 public school funding comes from local and state taxes, which hugely impacts which curriculum and standards are being taught in each state and district and leads to stark differences in what is being taught in different schools (Peter G. Peterson Foundation, as cited in U.S. Census Bureau, 2020). It is reasonable to conclude that no two schools look the same in the United States, even within the same district.

The Common Core Standards Initiative was developed in 2009 as a means to ensure that all students from all states shared similar educational standards and goals (Common Core State Standards Initiative, 2022). Although the Common Core Standards Initiative, which has been adopted by 41 out of 50 states, does not explicitly spell out guidelines or standards aimed at teaching climate change education in public schools, there is some room for interpretation amongst educators when creating lesson plans around these standards that could incorporate issue-based learning and climate change. These are both taken as subcategories of 21st-century learning, which is outlined as an outcome from the standards, however, that does not mean that these subjects are taught across the board in all schools or even classrooms (Common Core State Standards Initiative, 2022).

1.2.2 Next Generation Science Standards (NGSS)

In addition to the Common Core Standards, the Next Generation Science Standards (NGSS) were created in 2013 as a means to universalize science

standards since the focus of the Common Core Standards is on English Language Arts and Mathematics (NGSS Lead States, 2013). The final standard for grades 6-12, *ESS3 Earth and Human Activity*, includes educational standards to be taught on “Natural Resources, Natural Hazards, Human Impacts on Earth Systems, and Global Climate Change” (NGSS Lead States, 2013). The standards vary by grade and there are specific standards for each grade level respectively in primary school for grades K-5. There are also standards for middle school (grades 6-8), and finally for high school (grades 9-12). No specific standards related to the anthropogenic nature of climate change exist in the standards for grades K-5. The following standards are the ones related to climate change but do not specifically state that humans are causing these changes, however ESS3.B Natural Hazards does include the idea that humans can play a role in the reduction of natural hazards which implies that they play a role in the creation of them to some extent:

Grades K-2 ESS2.D: *Weather and Climate*

Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next (NGSS Lead States, 2013).

Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years (NGSS Lead States, 2013).

Grades 3-5 ESS3.B: *Natural Hazards*

A variety of natural hazards result from natural processes. Humans can not eliminate natural hazards but can take steps to reduce their impacts (NGSS Lead States, 2013).

The middle school (grades 6-8) NGSS standards are more explicit than the K-5 standards indicating the active role humans play in the rapidly changing climate worldwide. There is a standard called MS-ESS3-5 Earth and Human Activity in which the disciplinary core idea is as follows:

ESS3.D: *Global Climate Change*

Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding human behavior and on applying that knowledge wisely in decisions and activities (NGSS Lead States, 2013).

Lastly, some teachers may be able to interpret that the high school (grades 9-12) standard HS-ESS3-5 Earth and Human Activity takes on the role of how humans can be agents of positive change in light of the power that we have to destroy the environment, we also have equal power in preserving and rebuilding a stronger future. The core disciplinary idea for this standard includes:

ESS3.D: Global Climate Change

Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current future impacts (NGSS Lead States, 2013).

It is promising that there are content standards directly covering climate change, however, it is unclear how many states have adopted the NGSS as of 2024. In 2014, twenty states and the District of Columbia adopted them, and twenty-four additional states created their own standards based on a similar framework (National Science Teaching Association, 2014). It is important to note that these standards are voluntary so the states that crafted their standards based on them can pick and choose which aspects they deem important (Cho, 2023). Due to the fact that less than half of US states have adopted the official NGSS standards and that climate change education is included as a final standard, presumably a standard teacher may not reach those particular standards in content delivery due to time constraints (Foss & Ko, 2019). This is evident based on earlier studies that many teachers have indicated that they do not know the climate change educational standards in their state or district or that they do not have the time and resources to teach about climate change in depth which will be further discussed in the next section (Foss & Ko, 2019; Hannah & Rhubart, 2019; Khalidi & Ramsey; Nation & Feldman, 2022; Plutzer et.al, 2016, 2020). Furthermore, it is important to acknowledge that the NGSS standards are restricted to science classes in US classrooms and with the interdisciplinary nature of climate change and climate science it would be beneficial for climate change standards to be integrated into the content standards of other courses so students could gain greater exposure to the complex attributes of climate change (Hannah & Rhubart, 2019).

1.2.3 *A glimpse of hope: the case of New Jersey and Connecticut*

The discussion surrounding climate change education in the United States would be incomplete without acknowledging two new legislative actions passed in New Jersey and Connecticut – the only two states which have laws that require public schools to follow and teach the Next Generation Science Standards. In 2020, New Jersey was the first state to implement climate change standards in their curriculum for all grades from Kindergarten – grade 12 across all disciplinary subjects in publicly funded schools (Department of Environmental Protection, 2023). New Jersey Department of State’s education partner, SubjectToClimate, has created specific lesson plans related to the state’s climate change standards across each academic discipline including art, health, mathematics, science, social studies, English language arts, and world languages. These resources are freely available and easily accessible for teachers to use and classroom implementation (Department of Environmental Protection, 2023).

Similarly, in 2022 Connecticut passed a new legislation which requires the State Board of Education to help schools include climate change instruction in line with the NGSS (State of Connecticut General Assembly, 2022). Similarly to the bill in New Jersey, the bill requires the board of education to provide curricular and lesson support and resources (State of Connecticut General Assembly, 2022). Additionally, this bill safeguards against budget cuts in climate change education funding that can be a result of climate denying politics (State of Connecticut General Assembly, 2022). It is important to note that although other states have adopted the NGSS New Jersey and Connecticut are the only two states with passed state legislation that mandates these standards be taught at all public schools across all subject disciplines. Through the implementation of climate change education across multiple or all disciplines, students are exposed to climate change as more than just a scientific issue, but also one that is cultural, political, ethical, emotional, and controversial (Bleazbly et al., 2022).

1.3 Teachers’ Views and Feelings Towards Teaching Climate Change

In this section I explore previous research on teachers’ views and feelings towards teaching climate change in US classrooms. While reading through

relevant studies, I asked myself the following questions in relation to teachers' views and feelings: do teachers want to teach climate change? Why or why not do they want to teach about climate change? What factors may play a role in their willingness or unwillingness to teach it?

1.3.1 Teachers' views towards teaching climate change

According to an ongoing study at Yale University of n> 28,000 participants from 2008-2023 from all 50 US States, 72% of Americans do believe that global warming is happening, while 58% believe it is caused by human activity, and 44% of people report being personally affected by global warming (Marlon et al., 2023). Additionally, 75% of those surveyed support policy in which climate change is taught in schools. The above information is data from the general public, so how do teacher's views compare to the general public?

Previous studies on teaching climate change education in US schools indicate that teachers have mixed feelings about wanting to teach climate change in schools. One study involving 233 in-service teachers from the Dallas-Fort Worth, Texas region indicated that 96.6% of teachers felt that climate change should be taught in schools and that instruction should include actions and policies on how to deal with it (Foss & Ko, 2019). Another study involving 85 teacher participants from an undisclosed location in a school district in the Southwestern, United States revealed how the feeling of hopelessness contributed to teachers engaging less in climate change instruction, as they felt incapable of influencing future outcomes (Lombardi & Sintra, 2012). Furthermore a study involving 19 secondary science teachers from suburban areas in the Midwest, USA revealed that teachers who also felt more concerned about climate change were more likely to teach about it than those who were considered dismissive, doubtful, or cautious in the study (Liu et al., 2015).

In a large nationally represented study involving 1500 middle school and high school teachers from all 50 states, Plutzer et al. (2016) revealed three in four science teachers allocate at least one hour of climate change education in their lesson plans (it is unclear if that is one hour per week, month, semester, or the entire school year). This is a concerning trend based on the severity of the issue. In the same study, Plutzer et al. (2016) illustrated that 30% of teachers

emphasize the anthropogenic nature of climate change, meaning 70% of teachers leave out the crucial message from the scientific community that human activity is the primary cause of climate change. This does not necessarily mean that teachers do not believe that climate change is anthropogenic, however, many teachers may not teach it as so. This might be due to teachers themselves not knowing or believing that scientists agree that climate change is caused by human activity, as demonstrated in the same study when only 30% of middle school and 45% of high school teachers chose the correct option that 81-100 percent of scientist agree climate change is human induced (Plutzer et al., 2016). In this study, only 2% of teachers outright denied the occurrence of climate change and 15% believe that climate change is happening due to natural environmental causes. Although these figures are higher than the national average including all types of individuals, not just science teachers, in order for students to learn accurate information on climate change, it is important for teachers to present the information correctly as knowledge about climate change is correlated with beliefs on climate change (Nation & Feldman, 2022; Seroussi et al., 2019). This could be done by providing professional development courses to teachers, which has shown may induce attitude changes on global climate change and assist teachers in doing so (Liu et al., 2015).

1.3.2 Teachers willingness to teach climate change as controversial

As explored earlier, teachers are usually willing and eager to teach controversial topics at school to enhance students critical thinking, reflection, and interpersonal skills (Chen & Cui, 2022; Flensner, 2020; Kuş, 2019). However, when it comes to teaching climate change as a controversial topic, teachers again report mixed feelings. A recurring theme across the literature on the topic of teaching climate change is that teachers often report feeling more comfortable teaching “both sides” of the climate controversy meaning that climate change is a result of both human activity and natural causes (Foss & Ko, 2019; Hannah & Rhubarb, 2019, Plutzer et al., 2016). Plutzer et al. (2016) attribute this to three factors: overt pressure from the outside, teachers sometimes limited knowledge of climate change evidence, and teachers lack of understanding of the scientific consensus on the cause of GCC.

Firstly, teachers may feel pressure from parents and administrators not to teach climate change (although only 4.4% of teachers in his study reported such pressure, but in controversial issues, the small majority can make louder noise than the large majority). Further studies support this notion that teachers were more likely to present the climate controversy in a neutral fashion to their students due to fear of resistance from administrators (Hannah & Rhubarb, 2019; Nation & Feldman, 2022). Secondly, teachers often do not have the most up-to-date information on climate change and lack understanding of the key principles in climate literacy even on common science terminology, such as terms like 'weather' and 'climate' (Foss & Ko, 2019; Plutzer et al., 2016). Lastly, teachers are largely unaware of the consensus in the scientific community that humans are the main agents of climate change (Foss & Ko, 2019; Plutzer et al., 2016; Nation & Feldman, 2022).

Furthermore, previous research indicates that some teachers in the United States may prefer to "teach both sides" of the climate change controversy, as many teachers do not feel comfortable sharing their personal beliefs and knowledge on climate change with their students (Hannah & Rhubarb, 2019; Nation & Feldman, 2022). When teachers are faced with the challenging and personal task of addressing their own personal beliefs, they may be less inclined to cover the most contentious aspects of controversial scientific topics in the classroom (Nation & Feldman, 2022). It is sometimes argued that by covering "both sides" of the public controversy over the causes of climate change students are able to understand and recognize how the issue of climate change is perceived on a larger scale within the nation and students can come to their own conclusion about how they feel about climate change (Foss & Ko, 2019; Nation & Feldmann, 2022).

However, Nation and Feldmann (2022) argue that teachers must recognize that presenting climate change from a neutral standpoint can inadvertently promote biases that support the unscientific idea that climate change is not human caused and perpetuate the spread of misinformation. Covering both sides of a controversy can also be futile according to Lombardi and Sintra (2012) who argue that adopting a decisive stance when teaching topics leads to an urgent need to decide, thereby limiting the opportunities for critical examination and discourse of the relationships between evidence and alternative viewpoints.

Further supporting this idea Hannah and Rhubart (2019) propose that teaching climate change controversy with a “both sides” approach furthers a polarizing narrative. Alternatively, they suggest that teachers use a consensus informed approach that climate change is indeed anthropogenic. This in turn allows space for climate change education to be solution focused (Hannah & Rhubart, 2019).

Finally, while teachers recognize the significance of discussing controversial subjects, certain studies propose that teaching climate change as a contentious topic may be inappropriate. This is because the scientific community widely agrees that climate change is anthropogenic, rendering it misleading to stimulate debate against an established scientific consensus (Hannah & Rhubart, 2019; Khalidi & Ramsey, 2020; Plutzer et al., 2016). Kötter and Hammann (2017) propose that science teachers might encounter internal challenges when teaching controversial science subjects, as they may identify more strongly with their roles as a practicing scientists and feel uncomfortable engaging in reflective discussions on scientific facts.

1.4 Teachers’ Preparedness to Teach Climate Change

1.4.1 Prior knowledge and training

Many teachers do not feel adequately prepared to teach climate change due to their lack of formal training on the subject (Foss & Ko, 2019; Hannah & Rhubart, 2019; Herman et al., 2015; Liu et al., 2015; Plutzer et al., 2016). One particular study involving 233 teachers in the Dallas-Fort Worth region of Texas found that 75% of teachers received no formal education on teaching climate change which impacted their feeling of preparedness to teach on these issues (Foss & Ko, 2019). While Texas is traditionally the largest and most populous politically conservative-leaning state as well as the largest oil-producing state in the United States, it may come as no surprise that the political views on climate change may not always align with those of the scientific community (National Archives and Records Administration, 2023; U.S. Energy Information Administration, 2023). However, it is meaningful to note that a large majority of teachers did not receive climate change education training in their teacher preparation programs at academic institutions in the state, in which the teachings at these institutions are

based on scientific findings, which acts as further evidence of how political agendas and policies are deep rooted and multilayered in various levels of education in the United States (Hulme, 2009 and Hannah & Rhubart, 2019). Later on, we will further delve into the variation in teaching and learning between different states, as state to state discrepancies in schools and education are relevant for painting a holistic overview of education in the United States.

As a result of teachers lacking adequate training on teaching climate change, they may present incorrect or misleading information, therefore possibly perpetuating misinformation in classrooms which students may receive from the media or other non-scientifically founded sources (Foss & Ko, 2019). One piece of misinformation that teachers continue to present to their students across various studies is that climate change is a result of greenhouse gasses rather than being anthropogenic, or a result of human activity (Foss & Ko, 2019; Hannah & Rhubart, 2019; Herman et al., 2015; Khalidi & Ramsey, 2020; Liu et al., 2015; Lombardi & Sinatra, 2012; Nation & Feldmann, 2022; Plutzer et al., 2016; Seroussi et al., 2019). When teachers rely on information from the media, they may feel they are better informed about climate change science than they really are (Herman et al., 2015). This can again perpetuate misinformation, which is why it is important that teachers are accurately prepared to teach about climate change through their teacher preparation programs and professional development programs designed with resources from the scientific community (Liu et al., 2015).

1.4.2 Climate change standards missing in the curriculum

In addition to a complex curriculum across the nation, states, and districts, teachers report climate change standards lacking in their states curriculum and a lack of training as obstacles to teaching climate change education in the classroom (Foss & Ko, 2019). Additionally, teachers have demonstrated a hesitancy towards teaching climate change and other controversial issues due to the emotional nature of these topics, not necessarily wanting to share their personal opinions, and fear of pushback from administration, parents, or the community (Hulme, 2009; Lombardi & Sinatra, 2012; Nation & Feldmann 2022; Plutzer et al., 2016; Seroussi et al., 2019).

A recurring theme across various studies shares that teachers have reported that either their state does not include climate change standards in the curriculum or that they do not know the standards (Foss & Ko, 2019; Hannah & Rhubart, 2019; Herman et al., 2019; Khalidi & Ramsey, 2020). Findings from Khalidi and Ramsey (2020) comparing California and Texas secondary teachers' perceptions of climate change further support the existence of vast differences in teaching and learning across different states. Their study revealed that "65% of California teachers reported that they were aware that their science standards included human causes of climate change, while only 32% of Texas teachers did." Additionally, more Texas teachers (17%) than California teachers (10%) reported that they should include both sides of the climate controversy in their instruction (Khalidi & Ramsey, 2020; p. 674). This suggests that in Texas there is more room in education for disagreeing with the scientific consensus that climate change is human induced than in California, which correlates with political views respectively for each state with Texas being a republican led state and California being a democratic led state. A further study conducted by Foss and Ko (2019) in the Dallas-Fort Worth, Texas region also demonstrated that 45.5% of teachers noted that a lack of state standards in their curriculum was a significant barrier that prevented them from teaching about climate change. Hannah and Rhubart (2019) further suggest that the presence of clear state standards on the anthropogenic origins of climate change is important in ensuring that teachers have accurate knowledge on the subject, thereby facilitating that students also be taught the most up to date and accurate information on climate change.

Teachers at public schools across the United States design their lesson plans around state standards included within the curriculum. Many teachers struggle to cover all of the content for each standard and many teachers continue to teach content that will support students' performance in state-mandated, high stakes standardized testing due to both overt and perceived pressure from higher-up administrators and the state (Anderson, 2011; Scogin et al., 2017). If teachers already feel restricted to teach only certain topics which will be covered in standardized testing and climate change education is not explicitly included in state standards, the likelihood of a discussion on the controversial nature of climate change being included in a lesson is limited. Combined with this reality

that a significant portion of the education system relies heavily on standardized assessments and the learning gaps on climate change in the curriculum, it is unsurprising that discussion on the controversy of climate change is often only briefly addressed in most science classrooms across the nation (Plutzer et al., 2016).

2 RESEARCH DESIGN AND METHODS

2.1 Research Design

This study aimed to explore teachers' views and feelings on teaching climate change and its controversial nature in US educational settings as well as their feelings of preparedness to teach it. In order to explore this, I employed an empirical qualitative research method through semi-structured in-depth interviews with eight teachers working in public school in the United States. However, I ended up only using results from 7 of the 8 teachers, as after I reviewed the transcript from one interview, I concluded that the teacher did not answer my research questions sufficiently. Since the focus of this research was studying views and feelings, the use of interviews created a solid platform for exploring first-hand accounts of these perspectives (Flick, 2022). In this particular study, views about teaching climate change included teachers' opinions, beliefs, and perspectives on this topic and how those transcend into their classroom instruction. The term feelings in this study is related to teachers willingness to teach climate change and why (different factors) they may feel that way.

The exploratory approach of this qualitative study provided flexibility in formulating and positing questions, as well as in adapting the research design during the course of the study (Rymer & Winsor, 1993). Initially, I aimed to explore how teachers feel about teaching climate change as a controversial topic, however after the first interview I quickly discovered the value of learning about how teachers feel about teaching controversial topics in general to better understand their views and feelings. This was accomplished by maintaining reflexivity throughout the design and implementation phases and allowing for "emergence, exploration, imagination, and creativity" in finding ways to build upon existing literature to find out not only teachers attitudes and beliefs, but why they

have those attitudes and beliefs and how they are used in the classroom (Flick, 2022, p. 25).

As the data was collected, a systematic reflexive approach was adopted as a means to minimize personal bias, assumptions, and perspectives through self-awareness and critical reflection (Flick, 2022). This element was essential in acquiring a comprehensive understanding of views and feelings towards sensitive and emotionally charged subjects, as I aimed to prevent my pre-existing theoretical knowledge and personal viewpoints from influencing and potentially biasing the research. Previous studies on similar subject matters, particularly the most well know and referenced by Plutzer et al. (2016) adopted a positivist approach to generate large amounts of data on teachers' knowledge and beliefs. This current study expanded upon that knowledge to attain an alternative perspective in addressing why teachers hold certain feelings and how they manifest their beliefs and attitudes in their instructional strategies in the classroom.

2.2 Participants

The recruitment of participants took place through reaching out to my professional network of teachers on social media platforms (i.e. Facebook groups and Instagram), from which I found four participants. Additionally, I reached out to science teachers in California on the professional social media platform, LinkedIn, from which I found two participants. Initially, my intention was to enlist solely high school science teachers; however, upon further examination of school curricula I expanded my research to encompass teachers from all disciplines and grade levels, recognizing that controversial topics can arise in virtually any classroom setting. Once I found it challenging to find participants, I enlisted Goodman's (1961) snowball sampling method by asking teachers who already participated in an interview for references to other teachers they may know who would be willing to take part in this research project and found an addition two teachers this way.

The participants of this study were eight (n=8) teachers working in public schools in the United States as their main profession. The participants consisted of two male teachers and 6 female teachers and were scattered amongst the

main geographical divisions of the United States – West, Midwest, South, and Northeast with the majority of teachers originating from the west. TABLE 1 illustrates each research participants pseudonym, subject, grade level, years of experience, and geographical location of each of the teachers.

TABLE 1. US Public School Teacher Participants

Pseudonym	Subject	Grade Level	Years of Experience	Geographical Location
Maria	Multiple Subjects	Elementary School K-5	12 years	Bridgeport, Connecticut
Ana	Marine Biology	Middle School 6-8	4 years	La Jolla, San Diego, California
Mary	Civics & Economics	High School 11-12	2 years	Detroit, Michigan
Elena	Math & Science	High School 9-12	5 years	Malibu, Los Angeles, California
Sara	Multiple Subjects	Elementary School K-5	6 years	Bristol, Tennessee
John <i>(data was not used from participant)</i>	English	High School 9-12	2 Years	Los Angeles, California
Eva	Economics, US Government, French	High School 9-12	6 Years	Los Angeles, California
David	Biology	High School	6 Years	San Francisco, California

Note. Elementary school in the United States consists of students from kindergarten through grade 5. Elementary school teachers teach multiple subjects to their students including math, language arts, science, social studies, music, art, and reading. Students have one class teacher each year and one teacher usually teaches all these subjects to students. In middle and high school, students usually attend different classes for different subjects with different teachers. Teachers may teach more than one discipline per school year depending on the needs of the school.

2.3 Data Collection Instruments

I developed semi-structured interview questions similar to previous research on the topic of teaching climate change and controversy. The questions related to teachers' knowledge and understanding of climate change and were derived from the sample by Plutzer et al. (2016). The questions pertaining to teachers' attitudes towards teaching climate change in the classroom and teaching "both sides of the controversy" were modelled after Foss & Kos' (2019) and Khalidi & Ramseys' (2020) samples. In addition, I was curious about what could act as a barrier or facilitator for teaching climate change and teaching it as controversial in which those questions were modelled from Foss & Ko (2019) and Nation & Feldmans' (2022) samples. TABLE 2. displays those questions that were formulated and asked. It is important to acknowledge that given the semi-structured nature of the interviews, I took the opportunity to pose additional questions as they arose and did not stick to a script to enhance reflexivity and exploration (Galletta & Cross, 2013). For example, if a teacher brought up something I found interesting, such as parents' rights in education or parents pulling their students out of school to homeschool them, I would ask further questions about that topic. I also took personal notes in my notebook and had about half a page for each interview. I was fully committed to staying present and ensuring participants' voices were heard, aiming to foster an open and inclusive environment for their contributions. Each interview lasted 30 minutes to 1 hour and 30 minutes depending on the participants' direct interaction with teaching

climate change education and their enthusiasm towards climate change in general.

TABLE 2. Semi-structured research questions

Theme	Interview Questions
Introduction & getting to know participant	1. Could you tell me about yourself? Where you are from? Where you teach? What grade you teach? What subject(s) you teach? Your teaching experience?
Climate change standards	2. What are the climate change educational standards in your state, district, and school? 3. Can you share some examples of the topics you cover related to climate change and how you teach these topics?
Prior knowledge and preparedness	4. Can you explain your teacher training and /or professional development for teaching climate change? 5. How prepared are you to teach about climate change? 6. Do you feel that you have the educational background and skills to teach students multiple sides of a controversial issue? Why or why not?
Climate Change as Controversial	7. Do you think climate change is a controversial issue? If not, why and if yes, how? 8. How do you feel about teaching controversial topics in your classroom? 9. How do you feel about teaching climate change as more than just a phenomenon in science, but as a controversial issue in today's society that is caused by or exasperated by humans?

Sharing personal opinions

10. How do you feel about sharing your personal views when teaching controversy in the classroom?
11. Do you think your students should know your personal opinions on controversial issues discussed? Why or why not?
12. Do you feel comfortable teaching something you do not stand for? Why or why not?
13. How do your personal views on climate change shape the way in which you teach it?

External barriers or facilitators

14. How do you feel about discussing global warming or climate change with other teachers, administrators, parents, and individuals within the school community?
15. Is there anything that makes you uncomfortable when teaching about controversy in the classroom?

2.4 Data Analysis

To analyze the semi-structured interviews from this study, I adopted a thematic analysis approach. A thematic analysis is a qualitative research approach which uses a framework of extracting patterns, or themes, from the data outside the boundaries of specific theoretical paradigms (Braun & Clarke, 2006). My justification for using a thematic analysis is that I sought to learn about teachers' "lived experience, views, and perspectives...to understand what [they] think, feel, and do" (Clarke & Braun, 2016, p. 297). The flexibility of a thematic analysis allowed me to explore patterns and themes beyond the scope of the existing theoretical framework on teachers' views, feelings, and preparedness towards teaching climate change. It also granted me freedom to uncover themes that emerged organically from the dialogue rather than being guided solely by the predetermined interview questions (Clarke & Braun, 2013).

I conducted my interviews on Google Teams and used the transcription feature to transcribe each interview. I also recorded the audio of each interview should there be discrepancies in the computer transcribed transcription. After reading the transcription along with the audio, making adjustments to ensure that the transcribed audio was verbatim, deleting the time stamps from the transcribed audio, and combining sentences that were a singular thought from participants, I then proceeded with Braun and Clarkes' (2006) six phases of a thematic analysis.

Step 1: Becoming familiar with my data. Although the computer did the bones of transcribing, I found rather significant discrepancies with the recorded audio from my interviews, which prompted me to alter the transcription to match the conversation verbatim and catch minor nuances that the computer did not always capture. Doing so also supported gaining more familiarity with the data and similarly to Bird (2005), I felt that transcribing played an important role in the understanding and interpretation of the data. The length of the transcripts ranged from 14 to 25 pages long.

Next, I read over each interview again and highlighted where I asked my predetermined research questions. Then, I reviewed each interview again and highlighted the questions I had asked as a response to ideas that arose during the interviews. Each time I read through the interviews, I made notes of important ideas that arose during the interviews and also noted any recurring ideas that were relevant to my research questions.

Step 2: Generating initial coding. After gaining familiarity with my data, I generated codes that not only helped me to answer my research questions, but also helped me understand my data from an analytical perspective. In total I came up with 53 initial codes across the seven interviews being analyzed. Some examples of the codes I generated were “teacher stays neutral while teaching”, “teacher encourages critical thinking and decision making”, “challenges in discussing controversy”, “challenge faced by teacher”, “political polarization in education”, “teacher influences on students’ perspectives”, “parental involvement and motivation”, “educational policy”, “education preparation”, “curriculum and standards” etc. Initially I noticed how the codes I generated were ‘theory-driven’ in relation to previous literature on this topic, however, throughout the process I noticed the codes evolve to become more ‘data-driven’ (Braun & Clarke, 2006).

Step 3: Searching for themes. According to Braun and Clarke, a theme “captures something important about the data in relation to the research question, and represents some level of *patterned* response or meaning within the data set” (Braun & Clarke, 2006, p. 82). At this point I wrote down all of my codes on flashcards and spread them out across the floor. Visually seeing them this way allowed me to start grouping codes together and creating themes such as “teachers’ interests”, “education and autonomy”, “professional challenges”, “personal biases”, “critical thinking”, “teacher preparation”, etc.

Step 4 & 5: Reviewing, defining, and naming themes: I combined phases four and five of Braun and Clarke’s (2006) framework to form the themes for this paper, which became apparent as I organized my codes. Initially, I identified five themes, each with three to six subthemes. Upon revisiting the data and codes, I refined my analysis to three themes with three subthemes aligned with answering my research questions through an exploratory process. The first two themes pertaining to teachers’ views and feelings, emerged as ‘data-driven’ through latent coding of the interviews. Conversely, the final theme addressing teachers’ preparedness, emerged as predominately ‘theory-driven’, shaped by mostly semantic analysis of the data (Braun & Clarke, 2006).

2.5 Ethical Procedures

Considering the interview nature of this study, ethics were an important part of the entire data preparation, collection, and management process. After individuals initially consented to an interview, a preliminary email was sent to their either personal or school e-mail address, whichever they provided. The email contained information about the nature of the study, the research question and purpose, the questions to be asked, time required, what and how the data will be used for and a consent form.

The consent form, attached below as Appendix A, form detailed what is expected of participants and what participants could expect from the interview and myself. Participants were asked to read through and sign the form before we proceeded to the next step.

2.5.1 Data management plan

TABLE 3. Data Management

Type of data, a short description	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Will you process any personal data or other types of confidential information?	Give a rough estimate of the size of the data.
Student interviews: audio and transcriptions. Collected for Master's thesis.	.mp4 and .docx	Invitation to study sent via participants personal e-mail. Interviews done on Teams.	Yes, voice and indirect identifiers.	Less than 2 Gb

The participants were informed that the personal data that would be used during this research includes: their geographic location (city and US state), their profession (e.g. High School Science Teacher), and potentially their political orientation if it came up during the discussion as discussions on climate change in the US can sometimes lead to political discussions, however, I will do as much as possible to keep their identities completely anonymous throughout the entire process.

The data was saved on the TUNI OneDrive system on Microsoft Word and Teams. The transcribed files are password protected on Microsoft Word documents. The audio files are password protected on my personal computer since the feature to protect files on OneDrive is not available through the TUNI network. Each consent form is also password protected on Microsoft Word.

There is no data available that allows anyone to directly identify participants in this study. Each participant was given a pseudonym during the data analysis

and write up process. There is no identifying information available that can allow the pseudonym to be connected with the participants real name in the consent form, audio, or transcription of audio.

Upon completion and acceptance of the thesis, all of the data including consent forms, audio files, transcription, and notes I made in a notebook during each interview will be destroyed effective immediately.

3 KEY FINDINGS

3.1 *Theme 1: Knowledge Through Critical Thinking and Discourse*

The most prevailing theme identified in teachers' views towards teaching climate change is how teachers view teaching climate change as an opportunity to engage students in critical thinking and discourse. Each of the seven teachers interviewed expressed their commitment to fostering informed citizenship, critical thinking, and a respect for diverse perspectives amongst students while teaching about climate change and the sometimes polarizing underlying nature of it in American society. Six out of seven teachers in this study expressed that although climate change is often viewed as a controversial topic in the United States, they did not view it as a controversial topic in their schools and geographic regions because there is no questioning on whether it is happening in their personal views. This allows room for teachers to engage in critical inquiry and facilitate debate amongst students on how to mitigate climate change and participate in active citizenship in their local communities and society to help slow down the rate of climate change.

The teachers involved in this study expressed their personal commitment to climate justice, which might be an explanation for why they are interested in involving their students as active participants in addressing the climate crisis. In the following section, I will dive into the subthemes of engaging students in polarizing subjects, capturing student interests, and global perspectives and active citizenship.

3.1.1 Fostering critical thinking skills in the classroom

All seven teachers in this study expressed how they view it is important for students to critically reflect upon their beliefs and why they have those specific beliefs. By doing so they engage students in 21st century learning for the future (Trilling & Fadel, 2009). Asking questions emerged as an important component

in this section. Teachers emphasize critically asking their students challenging and sometimes uncomfortable questions in order to promote critical cognitive engagement with one's prior knowledge and ideas (Lowery & Jenlink, 2019). Teachers are able to foster critical thinking through self-reflection as teacher Sara from Bristol, Tennessee suggested during her interview.

I think that a really good role as a teacher [is to try] asking them to really explain why they [students] think what they are saying and maybe offer them an alternative suggestion and just give them questions to think about what they are saying. And also, it's quite a reflective process if you ask why. (Sara, Bristol, Tennessee, p. 6)

She further highlights the importance of asking questions that help probe deep self-reflection and encourage students to see themselves and explore their opinions outside of familiar boundaries. This allows for students to make more informed decision making, as well as helps to minimize personal biases and increases empathetic thinking (Lennon, 2008; Sarrouf, 2023).

It's important that I try and help students think critically for themselves...and it's good that like they can have their own opinion, like and understand why they have that opinion more than just because [their] parents have that opinion or that the people around [them] believe that. (Sara, Bristol, Tennessee, p. 7)

Asking a question as a response to a question asked is a common method used which supports students active engagement in their own learning (Pagliaro, 2011). Even though the teachers in this study made it clear that climate change is an issue that needs to be addressed, teachers view themselves more as a facilitator of critical thinking as opposed to a responder or expert themselves on climate change and its implications. This promotes not only self-reflection, but also allows room for bridging the relationship between thought and action which can lead to fostering ecologically sustainable values (Bleazby et al., 2022).

So maybe when they ask me a question, asking back, instead of just outwardly sharing what I think is how I tend to handle these types of situations. Unless they ask something that is black or white, like 'is this a flower' or something. (Maria, Bridgeport, Connecticut, p. 9)

Eva, from Los Angeles, California further emphasizes that in order to engage students in critical thinking teachers themselves must be equipped with the skills and pedagogies aimed at fostering critical engagement in democratic learning.

As a result of my studies, I have strong critical thinking skills and try to cultivate those skills within my students and encourage them to think for themselves, and not just believe everything they watch on TikTok. I even encourage them to question the things I teach them in class because well I am really knowledgeable, but teachers should also be challenged. (Eva, Los Angeles, California, p. 7)

In summary, teachers view teaching about climate change as a way to encourage students to critically engage and reflect on their current knowledge, beliefs, and views on climate change. Doing so may feel uncomfortable for both the teacher and students, however, a cornerstone of learning is fostering learning for the 21st century which is often achieved through introspection and discussion (Ojala, 2019; Trilling & Fadel, 2009).

3.1.2 Engaging in polarizing subjects in education

Teachers in this study viewed teaching climate change as a way for students to engage in polarizing subjects recognizing its significance for learning within a democratic society (Hess, 2002; Kuş, & Öztürk, 2019). Although the teachers did not view climate change as controversial in their schools, they expressed that because climate change is still a polarizing topic in US politics, students can gain further awareness about this when learning about it at school (Hulme, 2009).

The town that I worked in was in a very, very liberal place and so umm the [students] did understand that it [climate change] could be controversial and we did have like maybe a few little debates when students would ask random questions to each other and myself. Students would ask me if climate change is controversial to other people and it is good for them to understand that those kinds of topics can be controversial to some people. (Mary, Detroit, Michigan, p. 2)

By engaging in these topics in an educational and structured environment, students not only gain the opportunity to discuss these topics amongst each

other, but they also gain skills that can transcend into real world situations with family, friends, acquaintances, and anyone else they may encounter (Lennon, 2017).

I think it's really important for students to have the background knowledge that they can use to maybe like avoid getting into a heated debate with someone who has a different viewpoint. They should know that you are always going to encounter somebody at some point who has the opposite view from you...and I think it's really important for students to have background knowledge that they can use so they are not totally blindsided when they encounter someone with a differing perspective. (Mary, Detroit, Michigan, p.2)

Additionally, teachers view that exploring decisive issues in the classroom builds a solid foundation for students interpersonal and communication skills students can use in the workplace, where a lot of conversations will come up and it can be beneficial to be able to communicate with a wide variety of individuals with differing perspectives (Lennon, 2017).

I've noticed that a lot of people just like shut down and they're not interested to like talk about different opinions, and I just find that like having debate and arguments in the classroom that students prepare for actually prepares them for the difficult situations they will encounter with people in their future workplaces for example. (Ana, San Diego, California, p.13)

Tackling decisive topics in the classroom plays an important role in developing students' debate and interpersonal skills. Students should understand that while they may perceive a topic in a certain light, others will inevitably have differing perspectives and may elicit different reactions when addressing those topics. Through discussion in the classroom, students learn to recognize that what might be controversial to one person may not be controversial to another (Flensner, 2020).

3.1.3 Global perspectives and active citizenship

Teachers view teaching about climate change as a chance to enhance students' understanding of global perspectives on the issue and to empower them to participate as active citizens in addressing climate change (Gaudelli, 2016).

Elena, a teacher from Los Angeles, California integrates the actions of Greta Thunberg in her climate change instruction in her science courses, demonstrating to her students how individuals can be proactive in holding those accountable who contribute to environmental harm.

Everybody, I mean everybody should be called out at some point, and I guess it's probably hard for these big corporations, led probably by middle-aged and older men hearing it from this young foreign girl...I think it's important for students to know these kinds of things that aren't always like explicitly in mainstream sources. (Elena, Los Angeles, California, p.13).

Change does not always entail radical actions that make the news, teachers view that students can make a change in other ways, however, engaging as an active global citizen in grandiose ways is not always accessible for all students especially for those students coming from lower socioeconomic backgrounds. A teacher suggested how students may want to engage in what the teacher views as active citizenship, however, may not have the means to do so and suggests that in order to be actively engaged in the fight against climate change in California, it is easier to do so with sufficient economic means (Bamber, 2019).

So the frustrating thing that I see in my classrooms is that most high school students seem relatively aware of climate change, but aren't willing to make any concrete changes to reduce their environmental impact...but yeah, I have also noticed a socioeconomic component. In my last school I worked with a more affluent student body so more students had more resources to eat a vegan diet at home, drive electric or hybrid cars, have solar panels on their houses...have smart thermostats, eat organic food, compost, and just yeah overall be more conservation focused. And yeah on the other hand many of my students from lower socioeconomic brackets want to make some of these changes, but are not able to because their parents are on a limited income and maybe even have multiple children to feed, and they may not be able to afford electric cars, solar panels, organic food, etc. (David, San Francisco, California, p. 6).

Although this participant above feels that active citizenship entails specific actions that require sufficient economic means in California, other teachers simply view gaining knowledge and new perspectives and sharing them with one's community are also ways to encourage active citizenship. Additionally, it can be argued that those coming from lower socioeconomic means leave less of

an environmental footprint, meaning grandiose steps are not always necessary for embodying environmentally consciousness (Roberts, 2007).

I have assigned my students to create videos on relevant environmental topics for other students to see and interact with and work together to make posters promoting environmental conservation. And in my US government class we cover current events and have covered issues related to climate change. Students work in small groups and present on current events impacting the United States as well as how it relates to upcoming elections and propositions. (Eva, Los Angeles, California, p. 3).

Teaching about climate change presents educators with both the challenge and opportunity to engage students as active citizens in their communities and beyond (Bleazby et al., 2022).

In summary, teachers view teaching about climate change as an opportunity for students to gain critical thinking and inquiry skills that are useful for both their present and future interactions. Teachers also view climate change as an opportunity for students to engage in debate on polarizing topics and be prepared with adequate knowledge to have diplomatic discussion when they do encounter the inevitable situation of discussing opinions with others who have differing perspectives. Lastly, teachers view teaching about climate change as a change to encourage students to act as active citizens in either relaying information about climate change to their community or taking actions with the intention of reducing their environmental footprint (Bamber, 2019; Gaudelli, 2016).

3.2 Theme 2: Climate Change Education and Obstacles

The next theme identified is that there are significant obstacles teachers face both internally and externally which play a role in their feelings towards teaching climate change. As noted earlier, feelings in this study pertain to the different range of emotions teachers have when addressing climate change in the classroom, as well as the factors contribute to those emotional responses. Similar to previous literature, teachers in this study shared how they have mixed emotions on teaching about this topic in which some of these emotions acted as significant barriers to teaching it (Lombardi & Sinatra, 2012; Nation & Feldman, 2022; Seroussi et al., 2019). Feelings in this study ranged from passionate and

enthusiastic to cautious and weary, and dissociated. As noted in the first theme, the teachers in this study view climate change as an opportunity to foster critical thinking, inquiry, and dialogue in educational settings, however, that is only when they feel empowered by their students, professional learning communities, and school districts to actually teach the subject matter in a progressive manner apart from the contentious debate inflated in politics and economics.

I identified three primary obstacles teachers in this study face which shape the way in which they feel about teaching climate change and the instructional approaches they choose to take. Firstly, teachers grapple with whether they should share their personal opinions on climate change with students. Secondly, the rise of parental involvement and influence, often referred to as “parents’ rights” in public schooling impacts the topics teachers cover and how they approach them. Lastly, professional hurdles, such as lacking support from their professional learning community impacts the ways teachers teach about sensitive and emotionally charged topics.

3.2.1 Teacher neutrality and minimizing personal bias

In this study, all seven teachers expressed conflicting feelings about sharing their personal opinions on climate change with students. Although teachers did not view climate change a controversial issue personally, they did feel hesitant to implicitly share their personal beliefs about it with students for various reasons. Elena from Los Angeles expressed how she does not want to lose her composure in front of her students should she be questioned and it affects her negatively.

I don't think I'm 100% comfortable...I could see where someone might challenge me and I might respond from a personal standpoint instead of just giving an unbiased answer. I specifically try really hard to just present facts on climate change and ask discussion questions and see how [students] respond to seeing and hearing the facts I present them. (Elena, Los Angeles, California, p. 8).

As a teacher, setting and understanding limits and boundaries with students is important for creating a progressive classroom climate, however, determining those boundaries requires diligent reflection and constant reevaluation of

students and the different situations and conversations teachers have with them (Bernstein-Yamashiro & Noam, 2013).

It's tough because as a teacher, you need to kind of understand your authority and limits of when it's okay to share your personal opinions. It's like when can I talk about this? How much should I talk? Finding that balance can be challenging...also each student is different in what they can and cannot talk about and discuss. (Maria, Bridgeport, Connecticut, p. 7)

Similarly, teachers feel that it depends on the nature of their students on whether or not they wish to share their personal opinions.

It really depends on the topics, the students, the age, and the maturity level the students. Since climate change is not an issue we discuss as controversial at my school, I sometimes share my opinions with students if they ask, but I focus on letting them discuss amongst each other. (David, San Francisco, California, p. 4)

Another issue that came up is how students are often impressionable and teachers do not feel that their opinions should affect students' personal opinions on climate change.

I feel it's important to be objective as possible when teaching at the high school level since they are extremely impressionable at this age. I feel comfortable examining both sides of an issue because it is important for students to see both viewpoints before they come to their decision. (Eva, Los Angeles, California, p. 9)

Further supporting this notion, some teachers feel very strongly about cautioning on sharing their personal opinion with students due to their own personal experience as a student and feeling restricted to authentically express themselves at school because they already knew the personal opinions of their teachers.

I had a teacher in high school who made it very clear she was supporting uh the right-wing candidate...and it made it very difficult to have an open discussion and since everyone in high school just wants to fit in students were unlikely to share their personal opinions with their teacher if they felt it were going to risk their grade...so yeah with that in mind I do try extremely hard to refrain from being too

opinionated because I really do not want my students to feel ostracized like I did in high school. (Sara, Bristol, Tennessee, p. 13)

The findings reveal that teachers in this study feel they should exercise caution when sharing their opinions on climate change with students. Opinions may inadvertently surface if a teacher chooses to educate their students on certain topics, for example on ways one can be more environmentally conscious in their day to day lives. Such opinions can manifest through instructional decisions, approaches, and methods (Liu et al., 2015). It is difficult to state that teachers in this study are cautious about sharing their personal opinions with students because they fear pushback due different opinions existing about the nature of climate change and the efforts that should be taken to mitigate it, or if in general teachers feel they should remain unbiased in their teachings as they feel they are meant to act as informants rather than authoritarians of information (Hess, 2002).

3.2.2 Parental involvement and influence

The idea that parents are increasingly infringing on what is taught in public schools was a recurring theme that resulted in being a significant driving force in the way teachers feel about teaching climate change, as well as how they feel about teaching in general. The idea of parental rights in education pertains to legislation, typically supported by while conservatives which grants parents increased oversight over schools and what is taught in schools (Ben-Porath, 2023). Now there exists is a nationwide organization called Parents' Rights in Education with the goal of at limiting the inclusion of sensitive and controversial topics in US public education. Their mission "opposes the politicization of school curricula" and they believe that "By law, public schools are to remain politically neutral/unbiased, but increasingly schools are utilizing material derived from Marxist doctrine...[and] embedding political ideology into core subjects...and redirecting time and resources to teaching radical ideologies, such as critical race theory" (Parents' Rights in Education, 2023). Furthermore, Parents' Rights in Education (2023) insist that "such indoctrination in schools is anti-American, anti-white, and anti-capitalist". This organization is mainly opposed to comprehensive sexuality education, "radical" gender ideology (i.e. discussing pronouns, hormone

therapy, etc.), and critical race theory, or the idea that racism is systemic in the United States and beyond. While the website highlights the concerns noted above, many more issues pop up, prompting parents to seek greater influence over their children's education, as shared by the teachers in this study.

Teachers noted that they feel pressured by parents to teach and not teach certain topics, including climate change because it is still a politicized topic in the United States (Ben-Porath, 2023; Nation & Feldman, 2022; Plutzer et al., 2016). It is not uncommon for meetings to be called when parents complain, as schools and school districts do not want to risk pushback or other problems with the local school or community.

My school has really reactive policies...so when a parent complains about something you did or said that they didn't like everybody has to go into a meeting about how you're not supposed to do this or you are supposed to do that (Maria, Bridgeport, Connecticut, p. 8).

These types of situations can cause teachers to feel like they have to walk on eggshells because at the end of the day this is their job and they do still have bills to pay. Maria continued to share how she wishes she did not care so much about what others think, but it is inevitable not to when there is pressure coming from all sorts of directions.

I wish I could just do whatever I wanted, but at the same time, I really am a bit of a rule follower...I also have three children and I don't want to risk my job and make my life harder. (Maria, Bridgeport, Connecticut, p.9)

Furthermore, teachers can often feel defeated due to their decreasing autonomy over their classrooms and teaching, often because parents keep a very watchful eye on everything that their child is learning and sometimes feel the need to dictate small details.

Sometimes the parents are also in the classroom and it's a lot...it's like first you have your higher up figures that are, you know, watching what you do, even dictating what you're doing, and then the parents have a hold over them and us. And then it's just so tough to be like, constantly scrutinized...I know that [climate change] is a scientific phenomenon that is caused by humans, but I don't want to argue with parents so I just keep quiet and teach more about marine life since we live so close to the ocean. (Ana, La Jolla, California, p. 22).

What is happening is that some parents aim to have control over what their children do and do not learn. However, education is about learning concepts and ideas from multiple viewpoints and learning how to discern that information to understand fact from fiction and create one's own opinions and teachers in this study wish to have the autonomy to teach a wide variety of topics that include various viewpoints. Ultimately the "parents' rights" movement entails some parents wishing to leave out what they view as controversial and politicized topics outside of public education system.

So whether it's about climate change or diversity or anything that can be controversial, they would rather teach their students that at home and leave school for just basic school subjects. (Elena, Los Angeles, California, p. 16)

Too much parental involvement can leave teachers feeling stuck, powerless, and even may cause teachers to contemplate their place in society as an educator.

It's very frustrating because parents can petition the school board and they often win. Honestly, I don't see myself in this profession much longer since with just a lack of respect for teachers in education and the expectations to be a good teacher are ridiculously unrealistic. (Sara, Bristol, Tennessee, p. 2)

Despite the uproar certain parents have made, education and teachers still play a pivotal role in creating active, informed citizens.

Ultimately, just because a topic is controversial, administration as well as politicians and parents do not have the right to ban knowledge from being taught to our students. (David, San Francisco, California, p. 16)

The proliferation of parent involvement in curricular decisions demonstrated to put intense pressure on teachers to either avoid teaching about certain topics all together or refrain from teaching important aspects of topics. Teachers feel stressed about this, scrutinized, and drained when there is more time focused on what should and should not be taught instead of just allowing the school districts and teachers decide the curriculum. Cherry picking lesson plans and curriculum

also takes away from a cohesive learning environment that presents information from varying perspectives. Multiple issues are becoming politicized in the United States, which some may not view as political in Europe, and the problem is since many issues are political issues, they become challenging to talk about in public schools since political issues are not meant to be included in education in the US. Aligning climate change education with a similar approach adopted by other OECD countries, where there is no question on whether climate change is occurring, who causes it, and that imperative action needs to be taken to tackle it, would enable a shift towards emphasizing global citizenship and empowering students to act as agents of change, rather than being stuck on debating and propagating polarization (OECD, 2021).

3.2.3 Challenges in education

Ultimately, different obstacles in education lead teachers to feel restricted. Participants in this study disclosed that teaching has evolved from their passion at the beginning of their careers to now just merely a job after navigating unrealistic pressure and expectations. This lack of passion also applies to teaching about climate change education.

I had one situation where a parent asked me not to teach it [climate change] or even edge on it...and I don't want to feel uncomfortable given this is my job, because then you're like, well this is what is paying the bills too. (Elena, Los Angeles, California, p. 9)

The example above illustrates a reality in how one parent can manipulate parts of the learning environment for the entire classroom, as teachers may wish to avoid the social, professional, and potentially legal repercussions that could result from not accommodating that wants and needs of individuals both inside and outside of the classroom. What is happening with these teachers and what is happening in the United States a whole is the process of avoidance to evade uncomfortable situations and ridicule. Additionally, due to the bipartisan divide in politics, culture, and people, it is very difficult to sway people to believe otherwise, particularly when it is about a political issue, such as climate change (Hulme, 2009).

It's just wild that there is such an obvious divide in this country, but what is even more wild is how that divide is so obvious in education especially here in Los Angeles where everyone is very individualistic. I mean I have lived here for five years [after moving from Indiana] and have not yet met one neighbor. (Elena, Los Angeles, California, p. 23).

The extent of individualism plays an important role in what is happening in education in the United States. As mentioned earlier, parents would prefer to teach their children about topics they deem controversial which is probably a result of individualistic ideals embedded in American society. The idea of freedom of speech is often interpreted as one having the liberty to say whatever they want whenever they want to whomever they want without legal repercussion. This often spills out into schools where individual parents feel that their wishes are trump the education standards and this begins to restrict what is actually learnt at schools.

And they [parents] don't want you to teach like those kind of life skills you need to gain...I think the parents probably think that this type of thing might be their job and they don't trust the teachers to teach those skills. (Mary, Detroit, Michigan, p. 12)

As parents increasingly lose trust in teachers choices, decision, and leadership, teachers start to feel confused and pressed. They are confused as to what should or can actually be taught, and they feel pressed to not make a mistake or cross a line that will place them in an uncomfortable predicament particularly with demanding parents. Ultimately teachers wish they could make decisions about what is being taught instead of everyone else.

I find education [in the United States] to be disrespectful...some of the laws that are being passed about, like you know what can and can't be said in the classroom and wanting to restrict all these topics and removing and banning books from school, and that's ridiculous. Like you know, I think everything should be available and it's up to us [teachers] to decided what's right, what's wrong, and what not. (Sara, Bristol, Tennessee, p. 2)

In the end, teachers do not feel as autonomous in their roles as they would like to be. New challenges are thrown at them from multiple directions on a daily

basis and they are bombarded with unrealistic expectations to accommodate not only every single student, but their parents as well. Even though climate change is not as controversial as it once was according to the participants in this study, teachers still aim to teach the less controversial aspects of it so as to avoid backlash. Participants in this study feel censored in their role as educators and have a multitude of responsibilities to manage on a daily basis, which cut into their time to teach about climate change which we will now further discuss on how prepared teachers in this study feel to teach climate change.

3.3 Theme 3: Pedagogical Infrastructure and Dynamics

The final theme that arose in this study is that teachers feel they are not adequately prepared to teach about climate change due to their lack of formal training on the topic, curriculum constraints, and ever decreasing autonomy. Of all seven teachers interviewed in this study, only one participant, Eva, from Los Angeles, California shared that she felt very prepared to teach climate change. The others expressed being underprepared and wish to learn more about how to teach it to students particularly when the controversial aspects of it arise in class discussions. As we learned earlier, the only climate change standards that exist in the United States are those included in the Next Generation Science Standards, which not all states have adapted, and out of the states that have adapted them, only New Jersey and Connecticut have passed legislation that actually requires schools to incorporate these standards across all disciplines and grade levels.

3.3.1 Teacher training

In the United States, the path to becoming a teacher entails either studying liberal studies, which is a four and a half year bachelor's major as the path to becoming an elementary school teacher, or one can study a single subject for a four-year bachelor's degree and complete a six-to-nine-month teacher training program mostly focused on providing educators with teaching strategies, classroom management, and curriculum development. This means that unless a teacher specifically studies something related to environmental education, marine

biology, agriculture, forestry, ecology, plant sciences, or wildlife/biology, they most likely are not equipped with much formal knowledge on climate change. Furthermore, most of those majors do not necessarily prepare one to work as a teacher so the climate change education component is often an important missing piece, as I learned throughout my interviews.

So I majored in Marine Biology and minored in environmental studies and yeah my education prepared me to talk a lot about marine sciences and the effects that climate change has on the oceans and marine animals, but because I didn't study education in particular talking to kids is a lot different than talking to like, you know, your classmates or something like that. (Ana, La Jolla, California, p. 10)

In a somewhat similar situation, David expressed his desire to learn more about climate change and how to better teach it to this students. Due to the fact that climate science information is often changing and improving, it is crucial for teachers to have up to date information and training on the topic through professional development courses (Liu et al., 2015).

I feel prepared to teach climate change especially considering my educational background in science, but I also would really like to learn new strategies on how to teach it since I finished college over six years ago which is a long time when you think about how quickly the climate is changing. (David, San Francisco, California p. 2).

Understanding the most current climate science is just as important as mastering effective pedagogies for teaching different subjects, particularly for sensitive topics such as climate change, which can evoke a multitude of emotions (Flensner, 2020). Teachers in this study shared how their teacher preparation programs provided them with limited knowledge on how to address controversial issues in this classrooms.

I went to [a] University [with a] teacher preparation program that is like they say, an urban education program. We had one assignment aimed at teaching us how to teach controversy, but there wasn't much backing to it...like we didn't go into strategies for teaching controversy. (Mary, Detroit, Michigan, p. 10)

She continued:

Teachers are facing a lot of difficulties teaching controversy or controversial topics. So in my opinion, I think you know, teacher education programs should probably do a better job of preparing teachers for that. (Mary, Detroit, Michigan, p.10).

Almost any topic can be considered controversial, in the sense that people have a wide variety of opinions and perspectives, so it is important that teachers have comprehensive training with teaching strategies and pedagogies that allow them to address these issues with students using an open dialogue that will further support a progressive learning environment (Flensner, 2020).

A lot of my teacher training was on how like how to get the students thinking and making their own assumptions based on the information they're given or the materials they are given, and so there's lot of experimentation. But honestly a lot of what we do in school is just very different. I think a lot of teachers can agree that it's like there is theory and then putting it into reality is sometimes so incredibly different. (Maria, Bridgeport, Connecticut, p. 5)

Additionally, she feels that those who train her and make a lot of the rules for learning are actually quite disconnected from the reality of daily learning environments. This plays an important role in teachers' lack of preparedness to teach.

It's that a lot of times the rules that you have to follow are coming from people that don't spend lots of time with children at all and don't realize that it's just not going to work the way they are envisioning it to. And that is just so frustrating sometimes as a teacher. (Maria, Bridgeport, Connecticut, p.5)

Teachers do not feel that their teacher training programs prepared them to teach climate change effectively. Considering that education practices are often changing, most teachers are required to take some sort of professional development courses in order to renew their teaching licenses after a certain number of years (Liu et al., 2015). Teachers also feel a great disconnect between what is taught and what is actually implemented in classrooms. Learning theory does not necessarily effectively prepare teachers how to use it in practice. Every classroom is different every year and so it is quite challenging to prepare teachers

for all of the possible situations that might emerge throughout the school year. Something that is important for preparing teachers is implementing concrete, relevant, and explicit educational standards which teachers can follow, which is what leads us to our next point of consideration (Hannah & Rhubart, 2019).

3.3.2 Government education policies

As outlined earlier, there are no national climate change standards in schools in the US. The next generation science standards were created as a means to centralize scientific learning standards in line with the scientific community. In this study I was curious to see how these standards were or were not implemented (NGSS Lead States, 2013). What I learned is that four out of the seven teachers worked at schools that did follow the NGSS standards and were aware of the climate change standards in the curriculum. All of those teachers were teachers in the social science or science fields, the one elementary school teacher and the one middle school teacher did not use the NGSS standards. One high school teacher was not aware of the standards but does take the initiative to teach her students about climate change. The elementary school teacher I interviewed, Maria, from Connecticut said she does not use the NGSS standards in her teaching, even though Connecticut is one of two states that passed legislation that those standards are to be implemented across all disciplines and all grade levels. Again demonstrating a disconnect from theory and reality. Additionally, even though the NGSS standards may be implemented and recognized, they are often implemented differently based on location.

My lesson plans align with NGSS, however there were a couple issues when developing lesson plans at the aquarium and the beach with scientists. There would be a whole thing about how the scientists wanted to incorporate a lot of information that us teachers did not always find the most interesting or useful for our students. (Ana, La Jolla, California, p. 9).

She further reveals that consideration of the local community and their economic prosperity also plays a role in how they she is able to teach about certain aspects of climate change (Worth, 2021).

The local fisherman also did not like that we teach about overfishing being a problem...and we share a marine environment with them, so the higherups had their input to focus on echograms instead, which is really boring for the kids, but it's what the scientists wanted to put in there. (Ana, p. La Jolla, California, p. 10).

The example above further emphasizes the reality of the climate change debate in the United States. If an industry or profession is being called out, then it is important to protect their legitimacy and neglect or at least put to the wayside the acts that are being taken to inform and educate on these problems (Worth, 2021). Something else shared is that there are a lot more issues that teachers and students find to be more interesting and pressing than climate change, so it is often put off to the end of the semester to discuss and may not even be touched on due to time constraints.

In civics, it's one of the last standards because learning about foreign diplomatic issues and foreign government is one of the last things you do. So it usually doesn't get touched on most of the time because you only have one semester to teach everything, so it's like one of the standard groups that you either don't get to at all or you just touch on like very basic things from it. (Mary, Detroit, Michigan, p. 8)

It became very evident throughout the interviews is that teachers find the time to teach about climate change if it is something they are interested and passionate about, if not they find the time to teach about other topics that they are interested and passionate about (Hess, 2002).

I am unsure of the climate change standards at my school since I do not teach science courses. In my Honors French 3 and AP French classes, I teach students vocabulary about the environment and related to climate change. Students learn to express themselves in French, regarding global warming, pollution, CO2 emission, fossil fuels, solar energy...recycling, public transportation, electric cars, farming, and veganism. (Eva, Los Angeles, California, p.5)

It became clear that standards play a role in guiding teachers on what to teach, however, genuine concern and passion were larger indicators of whether climate change will be taught or not. It can also be said that a general interest in a subject also plays role in how prepared teachers are to teach climate change (Hess, 2002). Although Eva was unaware of any climate change standards at her

school, she took the matter into her own hands to teach her student about climate change through language learning as she is passionate about taking actions to be more environmentally friendly herself.

Teachers generally do not feel as prepared to teach climate change as they would like to be. There are infrastructural barriers such as lack of proper training, as well as state standards on climate change lacking in the curriculum or the standards have been altered to fit the constraints of economic and personal concerns. Even though teachers in this study feel that their freedoms and autonomy are not as high as they would like them to be, it is clear that if teachers want to teach more about climate change, they will take it upon themselves to learn the most up to date information on climate change and find ways to incorporate it into their lesson plans and instructional time particularly if explicit curricular standards are not in place.

4 DISCUSSION: EXPLORING TEACHERS' EXPERIENCES ON CLIMATE CHANGE EDUCATION

In this chapter, the findings from the present study will be further explored in relation to existing literature on similar subject matter. I identify ways in which climate change education could be improved in US classrooms and curriculum, as well as limitations of the interview data and recommendations for educators on how to address potentially uncomfortable subject matters such as climate change in the classroom in the future.

The central aim of this current study was to gain further understanding of how teachers feel about teaching climate change education and how prepared they feel to teach it. The findings seem to suggest that teachers have a lot of negative emotions around teaching climate change education due to the emotive and controversial nature of the topic in US politics and could benefit from further teacher training on the subject matter.

4.1 Controversy as a Means to Academic and Personal Growth

Contrary to the current political climate on educational policies towards climate change in the United States, the findings reveal that teachers personally do not view climate change as controversial and therefore feel that they can help enhance their students' critical thinking and discourse skills by presenting scientific information to students and engaging them in dialogue to critically think about their relationship with the natural world as well as ways to engage in citizenship in the climate crisis. The findings from this study confirm previous findings (Foss & Ko, 2019; Khalidi & Ramsey, 2020) that indicate how teachers from California are likely to emphasize the scientific consensus about climate change to their students and introduce individual actions that can be taken to

reduce one's carbon footprint. Four of the seven teachers who participated in this study are working in California and those teachers were the ones who showed most passion and interest in teaching climate change and action to their students. It must be noted that three out of the four teachers from California are science teachers, and climate change education is mostly prevalent in science classes in the United States, as Plutzer et al. (2016) concluded in their study, which could be a reason why these teachers mentioned how they are able to include aspects of creating change in their lesson plans.

Participants emphasized their aim to engage students in critical self-reflection and dialogue because it can help students overcome some of the negative emotions or feelings they may have about climate change and support action towards positive change for the future. Previous studies (Lennon, 2008; Woolley & Fishbach, 2022) have noted that creating the space to discuss different controversies around climate change can help students with empathetic and critical thinking and empathetic and critical thinking are indicators of coping skills and self-motivated growth in school. It is important for students to have these skills to apply later in life and in the workplace, as the purpose of the common core standards initiative in the United States aims to prepare students for success both in school and after they finish high school and enter university and the workforce (Common Core Standards Initiative, 2021).

Furthermore, the findings from this study suggest that teachers view discussion on climate change as a way to engage students in topics that they may have not already had previous knowledge or opinions on and build new knowledge based on research, discussion, and sometimes debate. Moreover, teachers in this study also view teaching controversial topics at school, such as climate change, as an opportunity for students to develop new their own or different opinions based on their own decisions and not that of their parents, political party, religion, etc. Participants emphasized how they aim to give students the information and skills they need to create their own informed decisions and opinions, which confirms a common theme from a study by Hess (2002) in regard to the way teachers aim to teach about controversial or sensitive issues. Climate change is an issue often discussed in US politics and economy and there are varying opinions on both the personal and national level on how climate change should be mitigated (Hulme, 2009). Similar to the findings of

Hannah and Rhubart (2019) who found that climate science should be integrated across all educational disciplines, participants in this study found it important for students to understand how climate change is intertwined with US politics and economy and learn how to make informed decisions about their opinions and actions towards climate change through having a holistic understanding of the climate debate through learning about it through other educational domains outside of only science courses.

4.2 Challenges Encountered by Teachers in Teaching Climate Change

Climate change can stir up many emotions in individuals. Some individuals may feel anxious, others may feel empowered to take inspired action to fight against it, or others may feel angry that nothing is being done to take care of the environment or that something is being done to address it. The results from this study confirm previous empirical findings that teachers tend to have mixed feelings towards teaching climate change due to the challenges that come with teaching the subject matter in the US (Byford et al., 2008; Nation & Feldman, 2022; Lombardi & Sinatra, 2012; Seroussi et al., 2019). On the one hand, teachers are eager to teach students on how to act as informed active citizens through engaging in critical thinking and discourse. On the other hand, there are multiple obstacles teachers face that make teaching about climate change challenging. The obstacles identified in this study include: the dilemma of sharing their personal opinions, parental involvement and influence, and professional challenges, such as a lack of autonomy. Ultimately, teachers feel their professional judgement is being scrutinized and would like more autonomy over what is taught in their classrooms.

Echoing the results of Nation and Feldman (2022), teachers in this study did not feel that they should share their personal viewpoints about climate change with their students. Likewise, validating the conclusions from Plutzer et al.'s (2016) study, teachers in this study felt that sharing their personal opinions on climate change might interfere their students' opinions so they found it most appropriate to remain as neutral as possible and sometimes even present information from 'both sides' of the climate controversy. In the United States, most

political issues are often binary due to the two-party political system and studies demonstrate that when republican legislators support a bill on climate policy then republican respondents are more likely to support the bill, and the same goes for democratic legislators and respondents (Boven et al., 2018; Stokes & Warshaw, 2017). As discussed earlier, many issues that are considered controversial in public schools in the US are also political issues, which is why there are usually two sides to an issue and why teachers suggest that they will often teach their students both sides of the climate controversy so students can make their own decision and form their own opinions about these issues (Hannah & Rhubarb, 2019; Kötter & Hammann, 2017; Nation & Feldman, 2022). Ultimately, there are many opinions on climate change and all contentious issues and it is difficult to put the issues of the climate controversy within the confines of two opposing perspectives (Hulme, 2019). It is unclear if teachers in the present study choose to often remain neutral in their teaching style because climate change can be an emotive topic or because teachers in general feel that they should for the most part teach from an objective standpoint (Byford et al., 2008; Lombardi & Sintra, 2012). Based on the data collected in this study, it seemed that teachers often exhibited feelings of disempowerment in their roles as teachers. These feelings may account for their inclination to withhold personal information regarding viewpoints and opinions in the classroom.

Results from research by Plutzer et al. (2016) suggest that some teachers, 4,4% precisely in their study, may experience explicit pressure from parents to not teach about climate change in their lessons. While 4,4% of 1600 teachers may seem relatively small, it's important to acknowledge that such incidents do take place in US classrooms and have an impact on teachers and students. Confirming these findings, teachers in this study expressed a hesitancy to address climate change due to concerns about potential fear of pushback and demanding requests from parents. Participants noted an ever-growing infringement of parent involvement in education at school using the terms 'parents' rights' or 'parents' choice'. There were instances shared by participants where parents voted to remove books due to having content they deemed inappropriate to parents. Furthermore, one participant from this study shared how it is becoming more commonplace for parents to sit in on class to observe what is being taught and how it is being taught. This participant added that there are

parents who cherry pick the curriculum and lesson plans as a means to control what information their child learns at school. This ever-growing movement makes teachers in this study, as in other studies, feel like they are being scrutinized, pressed, and marginalized within their professions (Hannon & O'Donnell, 2021; Nation & Feldman, 2022; Plutzer et al., 2019). Teachers exhibited a hesitancy to teach about climate change because they simply did not feel like dealing with potential pushback from parents. Since climate change can be a decisive topic, teachers noted that some parents would prefer to simply teach any topic that is considered controversial at home and teachers should stick to teaching basic school subjects. This also made teachers feel confused as it can be difficult for teachers to discern what is considered controversial and what is not, seeing as the teachers in this study do not view climate change as controversial, however, some parents at their schools do.

Additionally, parental involvement in education can make teachers feel that they have to walk on eggshells during their climate change instruction. In a study conducted by Byford et al. (2008), educators highlighted their tendency to succumb to parental requests to maintain their job security and reduce conflicts with parents, which is a sentiment shared by five teachers in the present study. Even though teachers in this study felt defeated by their parental counterparts, ultimately they still desire further autonomy and feel they should be able to make the decision about what is taught in class without having to accommodate the demanding and sometimes unrealistic needs of parents.

4.3 In-Service Training and Curricular Considerations

The Common Core Standards adopted by 41 states in the United States aims to have learning standards that are globally competitive (Common Core State Standards Initiative, 2022). Nevertheless, without adequately preparing educators to teach climate change effectively, and aligning standards with those of other nations committed to addressing the issue, American education risks not being internationally benchmarked with the European Union and other OECD countries. Similar to other studies that delved into how prepared teachers feel to teach climate change, the findings in this study reveal that ultimately, teachers do not feel prepared to teach climate change education due to a lack of formal

training on climate change content matter and pedagogical practices to teach it (Foss & Ko, 2019; Nation & Feldman, 2022; Liu et al., 2015). Additionally, missing standards in the curriculum particularly impacted non-science related teachers' instruction on climate change education (Hannah & Rhubart, 2019, Liu et al., 2015). Explicit and required standards play an important role in what is taught in classrooms and missing standards correlates with missing instruction (Hannah & Rhubart, 2019).

Consistent with previous research, teachers in this study shared that they lack sufficient training to effectively teach climate change education (Foss & Ko, 2019; Hannah & Rhubart, 2019; Herman et al., 2015; Khalidi & Ramsey, 2020; Liu et al., 2015; Plutzer et al., 2016; Seroussi et al., 2019). Despite studying science related subjects at university, teachers did not feel they had adequate knowledge to teach the most current information on climate change. In university level courses, it is important that the content knowledge is both more in depth and consistent with current climate research (Herman et al., 2015). Teachers also did not receive formal training on pedagogies to address climate change, particularly when the discussion would get emotive and address controversial aspects on the subject matter. Nation and Feldman (2022) emphasize the importance of teachers having the skills and knowledge to guide students during argumentative discourse as it allows students to better construct their own understanding on issues. Cross-disciplinary knowledge is especially important for addressing climate change in education as this is a phenomenon that spans into aspects of everyday life and all learning subjects in education (Bleazby et al., 2022; Hannah & Rhubart, 2019; Herman et al., 2015).

Missing standards from the curriculum plays a vital role in how climate change is taught in US classrooms (Hannah & Rhubart, 2019; Foss & Ko, 2019). Non-science teachers in this study did not have concrete and explicit standards for teaching climate change education and only made the time to teach about climate change in other disciplines (such as language and economics courses) when they themselves were passionate about the subject matter and took learning and knowledge of climate change education into their own hands. Previous research indicates that integrating climate change standards into the curriculum increases instructional time dedicated to climate change education (Hannah & Rhubart, 2019; Wise, 2010). Furthermore, instead of adopting a

polarizing “both-sides” approach, employing a consensus-informed approach can foster a more scientifically founded and informed understanding of climate change among students (Hannah & Rhubart, 2019, Plutzer et al., 2016).

Furthermore, even with the implementation of NGSS standards in the curriculum, teachers reported how outside stakeholders impacted which parts of the standards are taught due to personal economic interests. Economics plays an important role in how climate change is addressed in the United States and teachers in this study revealed how this plays out in real life situations in the greater San Diego region for example.

4.4 Limitations

Although the findings from this study are consistent with similar literature and the research questions were answered, it does not come without limitations that must be addressed.

Firstly, the small sample size with teachers predominantly from California only partially highlights the views and feelings of a very restricted subset of teachers. However, I did not intend to generalize from my study, I only wanted to explore how some teachers view climate change as a controversial topic. Next, when I reached out to participants about the study, it could be assumed that only teachers who feel that something needs to be done about climate change were interested in participating. Initially, I aimed to find at least one participant who may have felt that climate change does not need to be addressed in education to gain a deeper understanding of different views on this topic which exist in education and the general public, however, that was not the case in this study. Furthermore, as climate change can still be considered a controversial topic in the US, it is plausible that some people who I reached out to simply were not interested in participating and that the ones who did may have not whole heartedly share their views and feelings as it can bring up a lot of uncomfortable emotions that some may not be willing to address when tapping into personal beliefs and values. Some may feel uncomfortable sharing personal information with strangers and in this case I was a stranger to all the participants in this study.

This study could be further investigated by exploring the views, feelings, and preparedness to teach climate change of teachers New Jersey and Connecticut

as they are the only two states that now require climate change standards across all disciplines as some teachers in this study had very minimal experience teaching climate change education since they were not science teachers. The limited opportunities teachers have to teach climate change underscores the critical necessity for a comprehensive climate change standards in schools (Hannah & Rhubart, 2019).

4.5 Recommendations: The Pedagogy of Discomfort and a Call to Transformative Action Through Dialogue

Climate change needs to be addressed holistically in education, which includes engaging students in not only the scientific dimensions, but also the controversial and sociopolitical dimensions of it (Bleazby et al., 2022). Additionally, teachers need in-depth training that includes concrete pedagogies that aid in student engagement (Liu et al., 2015). In order to better address the controversial and sociopolitical dimensions of climate change, I propose that in-service training and professional development courses consider a 'pedagogy of discomfort' to engage students with each other, society, and our planet earth. The 'pedagogy of discomfort' approach was introduced by Boler (1999) to address the power relations of emotions and feelings in learning reflexivity through uncomfortable situations. Emotions play a critical role in how one perceives oneself, situations, and the world and impact on what one chooses to see and not to see (Boler, 1999). Pedagogy of discomfort is about challenging the status quo both internally and externally and exploring values, ideologies, and emotions beyond the realm of our perceived beliefs.

Critical self-reflection is a key component for challenging one's personal, social, political, cultural, and historical positions in the pedagogy of discomfort (Mills & Creedy, 2019; Ojala, 2019). Through an interpersonal reflective process in the classroom, students are given the opportunity to explore uncomfortable discussions through emotive processes that may induce uncomfortable feelings yet may also prompt interpersonal transformation (Mills & Creedy, 2019). The pedagogy of discomfort does not only intend to keep under careful control uncomfortable feelings for students, but suggests to teachers how to handle the array of negative emotions that arise when students begin having discourse on

controversial issues. It suggests for teachers to focus on keeping the discussion progressive and constructive since often the aim of this type of education has an end goal of transformation and a call to action (Ojala, 2019).

Through a pedagogy of discomfort educators can support their students in becoming active global citizens in confronting the uncomfortable reality of climate change by pushing them to engage deeply with the issues climate change poses for society and the planet (Gaudelli, 2016; Mercer & McDonagh, 2021).

As presented earlier, teachers may not always be prepared or comfortable to teach climate change as a controversial issue in their classrooms (Colston & Vadjunec, 2015; Khalidi & Ramsey, 2020; Lennon & Russell, 2008; Nation & Feldman, 2022), however in doing so teachers are doing so much more than just bringing these issues to light – they are “helping students question how they tell their own stories, how they engage with the community with those around them and whether they are willing to acknowledge what they don’t know” (Mercer & McDonagh, 2021, p. 26).

If teachers gain exposure to different pedagogies in their university level courses and professional development courses, they may be better equipped with the tools to teach students about climate change when it becomes decisive in education. Gaining formal training on the pedagogy of discomfort could not only help assist students in their learning and personal development, but it could also make teaching sensitive subjects, such as climate change more accessible to teachers.

This study highlights how climate change education in the US needs to be more comprehensive. Not only does a pedagogy of discomfort allow space for climate change to be discussed across various disciplines, but it also allows teachers and students to engage in difficult discussions in a progressive manner that could help lead to positive future change both individually and collectively.

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APPENDICES

4.6 Appendix 1: Consent Form

Information Sheet and Consent Agreement

This is an informed consent for participants who wish to be involved in the following study: ***On Teaching Climate Controversy: Teachers' Views, Feelings, and Preparedness Towards Teaching Climate Change Education as an Ideologically Controversial Issue.***

Below, I will explain the aims and methods of the study, what is expected of your participation, your rights, risks, and benefits of participating in this study.

The primary investigator in this study is:

Janice Johnson, Master's Student in Teaching, Learning, and Media Education, Faculty of Education and Culture, Tampere University

janice.johnson@tuni.fi

Why am I being asked to participate in this study?

You are being asked to participate because you have identified yourself as an educator in the public school sector of the United States and are a qualified candidate to discuss your views, feelings, and preparedness to teach climate change and the controversial nature of the topic in the classroom.

Why is this study being done?

The purpose of this study is to understand how climate change is taught in US schools and teachers' views, feelings, and preparedness to teach this topic.

What happens if I say “Yes, I agree to complete this study?”

Every part of your participation for this study is voluntary, so you may choose to end your participation at any time without penalty. If you agree to participate, you will be asked to participate in a 30 minute – 1 hour long interview on Microsoft Teams in which only audio responses will be recorded.

What happens if I do not want to be in this research?

You can choose to end your participation in the research at any time, and it will not be held against you.

What happens if I say “Yes”, but I change my mind later?

You can decide to end your participation with us at any time and it will not be held against you. You can also decide to end the participation and then participate again at a later time. Any incomplete interviews will be destroyed.

Is there any way that being a part of this study could harm me?

There are no risks associated with completing this study beyond those you experience in everyday life when discussing topics that can bring up complex emotions. However, we encourage you to share with the researcher if you feel uncomfortable with video recording. The interview will be both video and audio recorded with transcription, however, we can discuss turning off the video recording should you wish to do so.

What happens to the information collected for the research?

We make every effort to limit the use and disclosure of your personal information and other records. Your personal information, such as contact information, will be kept separate from your data and will be destroyed when the study is complete. The data from the audio and/or video recordings will be kept private and will not be shared with investigators outside of this study. Audio/video recordings will be destroyed after 6 months. We will never share your identity with individuals who are not part of this project.

Will there be any costs to me?

Aside from your time, there are no monetary costs to take part in the study.

Will photos, video or audio recordings be made of me during the study?

The interviews will include audio and/or video recording of the conversation for research purposes. However, photos will not be taken. Images of the video recording will not be publicized at any point.

Will information from this study be kept private?

Information about you will be kept confidential to the extent permitted or required by law.

Only Janice Johnson will have access to the identifiable data, and she will be responsible for anonymizing it before analysis. All members of the study only have access to the anonymized data. Data is shared via secure servers maintained by Tampere University, protected by user ID and name.

No identifiers linking you to this study will be included in any sort of scientific report that might be published or presented for academic purposes. Everyone in contact with the data (anonymized) will be asked to respect the privacy of the data and will sign confidentiality agreements.

Will I receive compensation for participating in this study?

No, but you may request to read a copy of the study after it has been published.

Who can I talk to? If you have questions, concerns, or complaints, you can contact Janice Johnson at janice.johnson@tuni.fi

Consent for participation in a research study

I have been requested to participate in the research study identified above. I have received information about the study in writing and have had the opportunity to ask questions from the researcher(s) conducting the study.

I understand that participating in the study is voluntary. I am aware that I have the right to refuse to participate and the right to withdraw from the study permanently or for a temporary period at any time and without giving a reason. I understand that any personal data collected during the study will remain confidential.

I understand that anonymized data will be archived. I hereby give my voluntary consent for participation in this study.

Place and date

Signature

Name in block letters

E-mail address