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MITIGATING CLIMATE CHANGE: UNDERSTANDING HOW TEACHERS
INTEGRATE SOCIAL JUSTICE THEMES IN ENVIRONMENTAL EDUCATION

by

Gregory Allen Simons, Jr.

A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctorate in Education.

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Saint Paul, Minnesota

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Dissertation Chair: Patty Born Selly
Reader: Tim Goodwin
Reader: Mindy Ray

ABSTRACT

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Climate change is an increasingly severe global issue with devastating repercussions for marginalized, poor, and vulnerable people. As a result, environmental education has evolved over the years to build upon outdoor nature study and ecological concepts to incorporate fundamental principles of social and environmental justices while addressing climate change. This qualitative research study employed both an online survey and semi-structured interviews to address two research questions grounded in the environmental justice movement to determine how social justice intersects with pressing global issues commonly found in environmental science curriculum. First, how do environmental science educators integrate social justice themes in their classrooms? Secondly, how has environmental education evolved to incorporate climate change education? Survey participants were taken from the Advanced Placement Environmental Science Facebook group, and individuals volunteered to participate in a follow-up, in-depth interview. The data from the survey indicated participants do in fact teach climate change, are motivated by altruistic principals, and incorporate social justice themes in their AP Environmental Science classrooms. Furthermore, the interviews were transcribed and coded, while memo writing was used to ground theory to answer the primary research question. Environmental science educators do in fact include social justice in their classrooms through case studies, local connections, college preparatory programs, and environmental literacy initiatives.

Keywords: Environmental Education, Social Justice, Environmental Justice, Pro-Environmental Behaviors, Climate Change, Grounded Theory, Memo Writing

To my wife and children and all others who like to play in the woods.

“I would have you be a conscious citizen of this terrible and beautiful world”

Ta-Nehisi Coates, *Between the World and Me*

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CHAPTER ONE

Introduction

Climate change is no longer some far-off problem; it is happening here, it is happening now

-President Barack Obama

Introduction to the Research Question

My father was my first naturalist. Although he had no professional training in botany, natural sciences, or agriculture, his interests and natural curiosity enabled him to be an expert in growing food and plants in our own tiny habitat, our yard. Together, we were always busy transplanting what we grew or discussing how to grow our gardens to encourage different wildlife to come to our ecosystem. We were the envy of our neighborhood, and I fondly remember how proud this work made my dad. My father taught me how to recycle, compost, and use resources wisely. In other words, I learned about sustainability at a very young age. I learned how to lower my carbon footprint before I even knew what a carbon footprint was or how my personal actions impact global systems. I learned of the interconnectedness of all living things through these significant childhood experiences. Most important, I learned my actions mattered.

My mother was my first teacher and I bring much of what I have learned from her to my classroom. The significant life experiences growing up outdoors have fostered a strong connection to nature which drives my sustainable choices today. I constantly seek to pass these beliefs and attitudes on to my children and students as these values shape my daily decisions and actions. I understand my pro-environmental behaviors (PEBs) emerged from being fully immersed in nature. I have fond memories of hiking through forests, climbing trees, stomping in puddles after rainstorms, and collecting spring flowers to make necklaces. I grew up loving and appreciating nature and the intrinsic

value of all living things. The development of my PEBs combined with my ecological knowledge have resulted in a greater awareness of the global impacts of anthropogenic climate change issues.

Loving nature and outdoor play have impacted PEBs and sustainability practices of people for generations (Howell & Allen, 2017; Kurisu, 2015). However, Howell and Allen (2017) compared several significant life experiences (SLE) to determine how these experiences lead to environmental awareness and discovered that “social justice concerns were rated as more motivating than biospheric concerns” (p. 1). In other words, the social connections individuals make within their community may influence environmental sustainability and PEB development just as much as understanding the ecological sciences and appreciating nature.

The study by Howell and Allen (2017) gave me pause. My PEB development was rooted in outdoor play as a child and content knowledge in college, and I carried these experiences with me to my classroom. This study transformed my thinking and made explicit how important social justice concerns are for people when developing their unique PEBs. The purpose of my qualitative study is to determine how environmental science teachers incorporate social justice themes in their classrooms to encourage pro-environmental behaviors among students throughout a school year. This brings me to my overarching primary question: How do environmental science educators integrate social justice themes in their classrooms? It is important to note that I am grounding my beliefs in the assumption that environmental science teachers already do integrate social justice themes in their teachings. Since climate change is both a major component of the Advanced Placement Environmental Science course and a global concern, my study will

address a secondary question: How has environmental science education evolved to incorporate climate change education?

General Overview of the Problem

Environmental education (EE) is a dynamic field and more opportunities to understand the correlation between social justice and pro-environmental behaviors (PEBs) is needed. This research will explore how teachers incorporate social justice thinking to develop PEBs in students. Therefore, the purpose of this qualitative study will be to understand how environmental science teachers incorporate social justice themes in their classrooms. Additionally, this study will examine how incorporating social justice themes has led to the inclusion of climate change curriculum in environmental education.

Environmental education must include relevant curriculum designed to encourage students to act towards mitigating climate change (Howard & Allen, 2017). The literature provides overwhelming evidence that human behavior has contributed to climate change (de Groot & Steg, 2009; Taberner & Hernandez, 2011). The dependency on fossil fuels and the resulting production of greenhouse gases have polluted our air, water, and oceans (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014). Van der Werff, Steg, and Keizer (2013) suggested that to effectively mitigate climate change, people “need to adopt environmentally-friendly actions” (p. 1). Van der Werff et al. (2013) delineated two distinct intrinsic motivations when it comes to adopting these actions: enjoyment-based intrinsic motivation and obligation-based intrinsic motivation. Enjoyment-based motivation refers to behaviors that are enjoyable or interesting while actions under obligation-based motivations are completed out of a sense of duty or responsibility to

others. To effectively teach climate change mitigation, I have created moments for my students to reflect on both types of intrinsic motivation which will be described below.

The Howell and Allen (2017) and Van der Werff et al. (2013) studies show why environmental education needs to incorporate more social justice themes in the curriculum to mitigate climate change. Biospheric motivations (Howell and Allen, 2017), or the enjoyment-based intrinsic values, include the love of nature, outdoor play, and outdoor recreation. Social justice themes are more rooted in altruistic behaviors via a sense of community and obligation-based values (Van der Werff et al., 2013). Both of these studies have been instrumental in my research. How do teachers create these values for students in their curricula? Furthermore, if social justice themes are currently considered important for climate change mitigation, how do teachers include climate change curriculum focused on social justice themes? My primary research question is more relevant now than ever before: How do environmental science educators integrate social justice themes in their classrooms? Secondarily, how has environmental education evolved to incorporate climate change education? In today's society, there is a deluge of misinformation about climate change issues in the news, on social media, and in Hollywood. This study will show the science behind climate change, the detriments of climate change, and make explicit the need for environmental education reform incorporating social justice themes to mitigate climate change.

Definition of Terms

The following terms will be used throughout this research study. These terms are common words used in environmental education. A deeper knowledge and appreciation for these terms will guide the reader's understanding and inform the reader of the

importance of climate change education and the incorporation of social justice themes in environmental education. Each term was carefully chosen and utilized throughout this work to describe the environmentally related social inequities that exist and the nuanced differences between environmental science and environmental education. My childhood and college environmental science experiences instilled a love of nature as well as the scientific knowledge to understand complex environmental processes. But, through my teaching and observing the effects of climate change through my travels, I have begun to understand the social complexities of climate change and the importance of environmental education's approach to sustainability. Below are terms frequently found throughout this work:

- **Anthropogenic** is a broad term used to describe a condition that is caused by human actions. Haluza-Delay (2012) uses this word throughout his work to describe the environmental justice movement and the inequity of shared resources. Those in developed nations contribute to climate changing gases more than those in developing nations.
- **Biospheric values** are conditions that have promoted a love of nature through outdoor play, experiences, and nature. A synonym is biophilia – the love of nature (Wilson, 1984). Biophilia is a major factor in my personal development of pro-environmental behaviors.
- **Climate change** is the general phrase used to describe how weather has changed through a period of time. Scientifically proven to have been caused by human actions, climate change is brought on by an increase in carbon dioxide gas in the atmosphere after unchecked burning of fossil fuels since the industrial revolution

as well as the release of methane gas. These gases trap heat in the Earth's atmosphere. Currently, climate change dominates news stories and political agendas. Climate change has become an important topic in environmental education and the curriculum of AP Environmental Science (Branch, 2019).

- **Ecocentric worldview** is a phrase recognizing the intrinsic value of ecosystems and the life that is found within the biosphere. This value and moral standing of ecosystems is present regardless of the value to humans. This is often referred to as deep ecology. Nature and ecological integrity are favored over individualism (Fawcett, 2012). My sense of deep ecology through my graduate and teaching experiences have informed my beliefs on the intrinsic value of all life.
- **Environmental Education (EE)** is a pedagogical, multicultural approach in environmental science that has emerged to create and foster sustainable relationships and to show the interconnectedness of all living things (Blanchet-Cohen & Reilly, 2013). Furthermore, EE allows individuals to expand on environmental science knowledge and engage in problem solving, increase awareness of global environmental issues, and take action to create a more equitable approach to environmental science to foster sustainability. I argue that EE strives to include social justice concerns in the curriculum, and I will use the term EE throughout this work when describing this education field.
- **Environmental justice** is the idea that all humans have equal rights to basic needs and conditions that the environment provides such as clean air, water, and sustainable resources (Bullard, 1996; Pellow, 2018).

- **Environmental science** is an interdisciplinary subject grounded in the physical, chemical, biological, and atmospheric components of the environment (Acott & McGibbon, 2008). Environmental science is a science centric approach to environmentalism that focuses on ecological knowledge, conservation, and preservation of the environment and Earth's resources. My study includes members of the Advanced Placement Environmental Science (APES) group. Therefore, when addressing the research question or my participants, I will use the term environmental science.
- **Intrinsic value** is a common phrase used in environmental education where living organisms have worth, independent of any benefit or service provided to humans. This is a cornerstone in environmental education (Fawcett, 2012; Wilson, 1984).
- **Pro-environmental behaviors (PEBs)** refer to those actions that support, develop, and maintain a healthy ecosystem for all people to enjoy (Howell, 2013; Hungerford & Volk, 1990; Kollmuss & Agyeman, 2002). I developed my PEBs through outdoor play but have learned to understand and advocate to others how climate change is a global concern.
- **Sustainability** refers to the practice where humans use resources wisely, fairly, and appropriately to ensure resources are available for future generations (Biermann, Kanie, & Kim, 2017).
- **Social justice** is defined as conditions where people have equal rights to basic human needs and conditions (Darling-Hammond, 2017; Nieto & Bode, 2018). Identifying ways social justice is integrated in an environmental science classroom is the cornerstone of this qualitative study.

Professional Interests in Climate Change Education

My educational philosophy and positionality drive my actions in my classroom as well as my core values in life. I have been afforded the opportunity of a diverse, rich education and my middle-class, affluent upbringing instilled a passion for lifelong learning, travel, and environmental stewardship. These experiences, and my connection to nature as a child, have constructed my pro-environmental behaviors and informed my research. Adams, Holman Jones & Ellis (2015) advocated using autoethnography for personal experience and subjectivity when designing research. While this study is not grounded in autoethnography, the results in Chapter Four are presented to share the experiences of my participants. Furthermore, Aldo Leopold (1949) championed environmental ethics in his writings and made the case that humans should leave no detrimental effects to the land, to plants, or to animals that live on it. This idea of leaving no environmental trace has stuck with me throughout my career and has influenced my teaching style today. While I strive to leave as little of an ecological footprint as possible, I realize I will both explicitly and implicitly influence my students and leave a lasting impression on them as I invite them into this climate change conversation and prepare them for their future. When all students feel invited to my learning community, real change can occur. As Block (2009) pointed out, “genuine invitation changes our relationship with others, for we come to them as an equal” (p. 117). In this instance, equal refers to environmental stewardship and the genuine invitation is centered around the gifts, stories, and ideas my students bring to the conversation. In a strong community, Block (2009) refers to gifts as the strengths people have. Focusing on gifts, and not deficiencies, strengthens a community.

The celebration of the gifts my students bring to the conversation is best illustrated through the emphasis of the global issues addressed in environmental education and the stories I like to share with my classes. For example, I completed my student teaching at Kodaikanal International School in Tamil Nadu, India. While there, I volunteered for Habitat for Humanity and spent a week digging foundations for the new houses being built. We used hand tools to dig and I watched in awe as the working elephants carried away the earth and tree debris left from our efforts. This was backbreaking work and one of the most educational experiences of my life at that point. I learned what extreme poverty, overpopulation, and land pollution looked like. I also learned what a community coming together to help others looked like. I frequently share my experiences from India with my students when discussing environmental justice topics.

I have taught students from around the world, and I value their experiences, choices, and stories they have to share. My students have strong and valid gifts they bring to our conversations. I use the above story of my time in India to describe the agricultural revolution and the shift from hand tools to machines with my AP Environmental Science classes. While mechanization has increased yield, it has also increased greenhouse gas emissions. My international travels have added additional layers to my pro-environmental behaviors which have connected me to nature and other cultures. My travels have also increased my awareness of inequalities of shared resources between developed and developing nations. My international teaching experiences taught me how truly global environmental issues impact different strata of people.

As a young child, I grew up in nature and have many fond memories of the outdoor play and recreation that accompanied the gardening work with my father. However, it was not until I became an environmental science teacher that I understood the full impact humans have on our biosphere. I began to question my individual practices. Was I wasting food? How can I conserve gas when driving? Do I recycle everything I possibly could? Without knowing it, I was beginning to solidify my burgeoning pro-environmental behaviors.

Kollmuss and Agyeman (2002) succinctly defined PEBs as those actions that minimize negative impacts on the natural world. Through my own self-reflection and master's degree work, I began to challenge my students to develop their own PEBs without the prescience to question where these behaviors came from. Thus began my work of examining my environmental education approach and guiding my students to their own pro-environmental behaviors.

The models from the 1970s of fostering pro-environmental behaviors were based on a linear progression (Hungerford & Volk, 1990; Kollmuss & Agyeman, 2002) that environmental knowledge led to positive environmental attitudes to then pro-environmental behaviors and finally to actions. However, both researcher groups reported that these models are only part of the conversation. Yet, today, most curriculum assumes that "more knowledge will lead to more enlightened behavior" (Kollmuss & Agyeman, 2002, p. 241). My pro-environmental behaviors were developed by biospheric experiences from my childhood and exposure to science in high school and college. It was not until my student teaching and graduate experience where I started to have that approach challenged when examining the relationship between the environment and

community. Seeing poverty in India challenged the affluent upbringing of my childhood. Witnessing the effects of pollution on coral reefs while diving throughout Asia taught me of the anthropogenic factors of climate change. Experiencing the effects of devastating forest fires in California instilled in me the intrinsic value of all life. These experiences challenged my thinking and created moments where I began to approach global issues through the environment, social, and economic framework differently. I quickly learned the benefit of framing global issues through this approach to give my students moments where they can challenge their own thinking and begin to see the inequities of the impacts of these global issues. Professionally, I noticed the need to change my approach to environmental education to supplement content and knowledge with moments of altruism and social connections between people.

My approach to environmental education begins by framing all global climate related issues through the triple bottom line of sustainability (Gough, 2012; Lowe, 2004). Lowe (2004) described the triple bottom line as a graphical tool which frames global issues from a sustainability approach by acknowledging the economic, social, and environmental frames of global issues. Global sustainability, a professional interest of mine, refers to the wise consumption of shared resources so that they may be available to future generations. Therefore, my students and I examine global issues through the social, economic, and environmental impacts that hinder global sustainability of our shared resources in my APES classes. Each global impact including food production, disease, biodiversity loss, energy, and pollution are analyzed through this lens, and students make connections to their own positionality and how these issues affect communities in both developed and developing countries. These global impacts, positionality statements, and

development stages will be discussed at length in Chapter Two to frame my position that teachers need to incorporate more social justice themes in environmental education to mitigate climate change.

Goals of my Research

The ultimate goal of this qualitative study is to determine how environmental science educators integrate social justice themes in their curriculum. This will be done through a survey and interviews of environmental science educators who belong to a global AP Environmental Science (APES) group on Facebook. Early on in my doctoral studies, I gravitated towards environmental education literature and found exemplar works on pro-environmental behavior development by Harold Hungerford and Trudi Volk. I initially wanted to study how individuals develop these ideas and the literature often cited by these two environmental authors. However, recent work by Howell and Allen (2017) introduced the importance of social justice when developing PEBs in students. The dynamic nature of environmental education was becoming clearer and a review of environmental education policies and changes was needed to understand how social justice themes can be integrated in contemporary curriculum.

Groundbreaking research studies by Hines, Hungerford, and Tomera (1987) and Hungerford and Volk (1990) have become contemporary examples for environmental education reform. Hines et al. (1987) described what responsible environmental behaviors looked like while Hungerford and Volk (1990) began to understand how these responsible environmental behaviors came about. These innovative studies have laid the foundation for research connecting PEB development to social justice environmental themes and for the change in environmental education to include framing climate change

in terms of social responsibility. Research has shown that environmental education is not a linear process, but rather a discipline that incorporates the social impacts of global environmental issues (Cermak, 2012; Howell & Allen, 2017, 2019; Reese, 2016; Shepardson, Niyogi, Roychoudhury, & Hirsch, 2012). As a result, my research has one goal, grounded in my research questions and supported by research: How do teachers integrate social justice themes in their classrooms? Clearly, the research supports the paradigm shift in environmental education by incorporating more moments of social justice coupled by ecological content knowledge. I would argue the knowledge comes from understanding the dynamics of climate change, and the action to mitigate climate change comes from examining how global issues impact sustainability through the triple bottom line framework. In other words, how do teachers make explicit the need for social justice to reach sustainability? The mitigation of climate change, as a result, would thus be a positive externality of this work. This work will then be used as a resource for the construction of a curriculum that includes moments of social justice integrated in the environmental science curriculum that I experienced as a student.

Significance of this Research

Previous environmental education studies have been instrumental in framing my research. Hines, Hungerford, and Tomera (1987) published research on how pro-environmental behaviors influence personal choices in terms of making local, sustainable choices. However, at the time of their research, social justice in environmental education was not fully developed (Dillon, Heimlich, & Kelsey, 2012; Howell, 2013; Howell & Allen, 2019). The push for outdoor experiences was used as a motivator for pro-environmental behavior development among students (Kollmuss & Agyeman, 2002).

Furthermore, a study by Hungerford and Volk (1990) noted shifts in environmental education to include more outdoor experiences to foster biospheric appreciation for nature to develop these PEBs on a more global scale. My educational experience was rooted in these research paradigms and lacked significant social justice themes.

Gough (2012) described the history behind the notion of thinking locally and acting globally in environmental education. Historically, environmental science took the pragmatic approach to teaching concepts, ideas, and relationships among the environment and human beings through knowledge and scientific concepts (Dillon, Heimlich, & Kelsey, 2012). Environmental education includes environmental knowledge coupled with a deeper understanding, appreciation, and attitude for global engagement grounded in relationships (Dillon, Heimlich, & Kelsey, 2012). Therefore, I propose environmental science has shied away from environmental advocacy while environmental education is beginning to address it with social justice inclusion. This will be further developed in Chapter Two.

After locating and reading these studies, I sought out additional research highlighting the importance of using social justice themes to frame environmental problems. McKeown and Hopkins (2010) described how the world is “far from being equitable” (p. 17). Furthermore, students understand and realize this gap and want to do something about it. I have noticed the same from my students when I frame global issues like famine, food security, and climate change. I began to see the connection in the literature between developing pro-environmental behavior and social justice. However, there is another gap in the literature. It takes more than just awareness of social justice themes for effective action. There needs to be concrete methods for including social

justice themes in environmental education to combat global issues like climate change. I want to determine how environmental science teachers do this.

In summary, outdoor experiences, as noted in literature from the 1980s and early 90s, help to develop pro-environmental behaviors and sustainable choices made by individuals. But these studies lacked pedagogical techniques to cultivate these behaviors in society. Further research indicated the importance of social justice to enhance pro-environmental behaviors in young people today. Therefore, my research is significant in determining contemporary pedagogical methods of teachers incorporating more social justice themes in their classrooms to combat global issues such as climate change.

Professional and Personal Goals

My research goals can be divided into professional and personal categories with significance to others in my field. Professionally, research has pointed to how environmental education is changing and teachers experience curriculum dilemmas when incorporating outdoor activities in the classroom (Cermak, 2012; Howell & Allen, 2017; Reese, 2016). Understanding how teachers integrate social justice themes into environmental education curriculum does have direct implications for my own teaching practices. As a classroom teacher, I constantly look to my colleagues for guidance, ideas, and resources to inform my teaching. Gould, Ardoin, Thomsen, and Roth (2019) discussed environmental concern as an emerging theme in the field of environmental education as “a general attitude related to evaluation of environmental protection” (p. 334). However, Gould et al. (2019) were quick to point out that general concern lacks the specificity required to incorporate more social justice themes in curriculum. This is consistent with the work conducted by Ardoin, Bowers, Roth, and Holthuis, (2018), who

examined how environmental education literature and research has changed over the past 20 years to include not only environmental knowledge (general concern) but also more occurrences of the environmental attitudes, competencies, behavior, and environmental stewardship of students. I would group these outcome domains under the social justice themes discussed.

My ultimate goal of this research is to continually reflect on and hone my teaching skills and become more knowledgeable in current trends of environmental education. As environmental education shifts from focusing on biospheric experiences to social justice inclusion as a leading cause of PEBs development, I would like to discover how environmental educators practice this, foster it, and address potential barriers that exist. The inclusion of social justice themes in environmental education has never been more relevant than it is today.

While I will benefit from this work, two additional stakeholders will as well. Other environmental educators who wish to make anthropocentric global issues key in their environmental classrooms may find my study helpful. I hope to discover explicit strategies, themes, and barriers to understand how teachers incorporate environmental justice initiatives in their teaching. Indirectly, students will benefit as well with a greater sense of community development and an understanding of how their positionality influences their behavior and biases. Secondly, I believe potential curriculum writers, educational leaders, and conservationists will be interested in this study to understand the heuristic approach teachers use to combat climate change and other anthropogenic issues, as well as to understand how to overcome barriers that prevent EE from fully utilizing a social justice approach to sustainability and PEBs development.

My Research Paradigm and Worldview

My connection to nature, as fostered by my father at a young age, was transformational and integral to my own PEBs development and love of nature. The first time I went scuba diving as a young adult was another transformational moment in my life. The explosion of color, the diversity of life, and the vastness of the ocean personified how I am just one piece of the intricate dynamics of our biosphere. Early on in my doctoral studies, these moments have caused me to reflect on my own PEBs development, how I approach my environmental education classroom, and the awareness of how EE has evolved to be more collaborative, empowering, and a vehicle for environmental advocacy as it diverges from environmental science which fosters scientific knowledge. Furthermore, immediately entering my doctoral studies I learned of the importance of community and how collaboration with educators around me would, in fact, inform my learning. Community and collaboration were made explicit to me. A classic text on research design by Creswell (2007)) described the transformative or advocacy/participatory worldview to include more collaboration and community empowerment. In other words, the evolution of EE to incorporate social justice themes now includes advocacy for the environmental rights of others to address the global issues that will be presented in Chapter Two. Everyone has the right to clean air, water, and shared resources. Everyone has the right to clean, nutritious food, medicine, and farmland. Everyone has the right to clean energy regardless of their socioeconomic status. Specifically, these rights are collectively referred to environmental justice (Bullard, 1996; Pellow, 2018). Therefore, the collaborative nature of the APES Facebook group was chosen as the participant pool for this study. Social media sites, like this Facebook group,

have created a massive opportunity for collaborating and sharing resources with other educators in the same field (Gikas & Grant, 2013). Likewise, Selwyn (2012) described the collective exploration and interaction that social media sites like Facebook provide for teachers. The APES Facebook group exemplifies the collaborative efforts for sharing ideas and resources to make the educational experiences better for students.

To address my primary research question on how environmental science teachers integrate social justice themes in their classrooms to address climate change requires me to have conversations with the professionals working in the field. As Creswell (2007) noted, an advocacy/participatory worldview lends itself nicely to qualitative data collection as advocacy research provides “a voice for these participants, raising their consciousness or advancing an agenda for change to improve their lives. It becomes a united voice for reform and change” (p. 9). Throughout my study, I will make this explicit as I work with other contemporary AP environmental science teachers through a worldwide Facebook networking group of more than 6000 members. Through a qualitative survey and interviews with participants from this Facebook group, I will learn what methods are currently employed to integrate social justice themes into environmental education curriculum. My participants will act as a united voice for change as I learn how my participants mitigate climate change through the fostering of pro-environmental behaviors through the lens of social justice.

The inclusion of social justice themes in environmental education is more relevant now than ever before for our students. A continual concern and recurring theme in environmental education is conservancy and sustainability (Campbell, Medina-Jerez, Erodgan, & Zhang, 2010). Yet, according to these researchers, environmental education

is not a central focus in the National Science Education Standards. In other words, important global environmental issues, like climate change, are inconsistently taught in schools. Without unifying standards, environmental education is left to teachers with a variety of training, interests, and availability. It is argued that topics like climate change that have a fundamental connection to social issues should be taught consistently throughout schools.

Not only is social justice inclusion important for sustainable development, it is also critical for the development of the diversity, equity, and justice identities of our students in our world today. Teaching Tolerance (2020) defines diversity, equity, and justice identities collectively as a set of principles that define the characteristics of a person. These identities are where biases reside. My study will confirm how important this work is to show that environmental and global issues are a matter of environmental justice. Marginalized individuals feel the burden of climate change more severely than others (Pellow, 2018). While the Tragedy of the Commons (Hardin, 1968) continues to be relevant today, it is magnified when the access to shared resources and common spaces is inequitable between global citizens. Now is the time for environmental educators to teach students the environmental knowledge needed through a social justice experience in order to mitigate the detrimental effects of global issues. Through a social justice lens, students learn social competencies like empathy, decision-making, and conflict resolution (Darling-Hammond, 2017). These are critical skills necessary to address global environmental problems.

Chapter One Summary

The purpose of this qualitative study is to address the primary question: How do AP environmental science teachers integrate social justice themes in their classrooms? Previous studies by Hungerford and Volk (1990) and Kollmuss and Agyeman (2010) described the importance of outdoor experiences and environmental knowledge in the development of pro-environmental behaviors. However, works by Howell and Allen (2019) suggested social justice is equally important to pro-environmental behaviors and increases positive environmental attitudes and actions. These behaviors lead our global society towards sustainability. While working collaboratively, global sustainability is required to address global environmental issues like climate change. The environmental justice movement and research conducted by Bullard (1996) and Pellow (2018) have shown that there is not equal access to shared resources, and marginalized individuals feel the burden of climate change more than others. Therefore, there is more work to be done. My qualitative study will begin with a survey to determine if AP environmental science teachers report integrating social justice themes in their curriculum and to determine current practices and attitudes in environmental education. Secondly, in depth qualitative interviews will be conducted with participants from the global APES Facebook group to determine how social justice themes are incorporated in their curriculum. This research will have lasting implications for AP environmental science teachers and the environmental justice movement.

CHAPTER TWO

Review of the Literature

The scariest part of the chemistry of global warming involves 'feedback loops' – the idea that as you raise the temperature you cause changes that will raise the temperature even more

-Bill McKibben, *The End of Nature*

Overview of the Chapter

Chapter One provided the goals and rationale of this qualitative study. This study aimed to determine how environmental science teachers report the use of social justice ideology in their curriculum and teaching. Secondly, this study aimed to determine how environmental education has evolved to include climate change topics. The need for social justice inclusion in environmental science curriculum is relevant today to mitigate the effects of climate change (Bullard, 1996; Pellow, 2018).

Chapter two will review current literature used to frame this study through several main categories. To begin, a history of environmental education will be provided to describe the origins of environmental science and the development of pro-environmental behaviors. Secondly, the science of climate change will be reviewed to illustrate the need for pro-environmental behavior development and how these areas are addressed in the Next Generation Science Standards frameworks. Lastly, a thorough review of social justice education at the secondary level will provide the background for the inclusion of environmental justice education. These categories have framed the research question and guided the survey and interviews to address the primary and secondary research questions: How do environmental science educators integrate social justice themes in their classrooms? Furthermore, how has environmental education evolved to incorporate climate change education?

Introduction

There is widespread scientific agreement that climate change is occurring mostly through anthropogenic actions (Bouman & Steg, 2019; Howell, 2013; Kollmuss & Agyeman, 2002; Plutzer et al., 2016; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014). Yet, adoption of pro-environmental behaviors (PEBs) seems to be lacking for a variety of reasons. For example, Bouman and Steg (2019) noted that individuals tend to make lifestyle decisions by prioritizing choices which are financially responsible and convenient. Environmentalists refer to these choices as barriers to individual development of PEBs of individuals (Van der Werff, Steg, & Keizer, 2013). Adoption of these pro-environmental behaviors do not maximize individual interests. Rather, the collective PEB benefits the communities and the environment through altruistic motivation and social justice connections.

Environmental education has shifted to include more climate change curriculum after the groundbreaking work of Hungerford and Volk in the early 90s (Ardoin, Bowers, Roth, & Holthuis, 2018). Furthermore, the recent work of Howell and Allen (2017; 2019), Bouman and Steg (2019) and Cermak (2012) indicated that PEBs are more naturally cultivated when global issues are framed using a social justice lens. However, the environmental education literature linking environmental education, environmental quality, and methods to teach climate change through a social justice lens still remains sparse (Cordero, Centeno, & Todd, 2020). In order to determine how environmental educators integrate social justice, this research will show first the science behind climate change and how humans are at the center of several global issues involving environmental degradation and social justice. Then, a full examination of the barriers that exist to pro-environmental behavior development will be used to describe the inclusion of

social justice themes in environmental education with the goal of mitigating climate change.

History of Environmental Education

Early Influences

Environmental education curriculum and practices have been evolving for more than 100 years in response to social and environmental changes that have occurred over generations (Dubois & Krasny, 2016). These changes and adaptations have been made in response to current worldviews during those times. For example, Bailey (1909) published one of the first books on environmental education that posited nature study as a way for all individuals to enjoy a better life through nature. This position is an example of some of the earliest forms of biospheric considerations, or the love of nature, as a means to qualify how environmental education should be approached by educators.

In his work, *The Nature Study Idea*, Bailey (1909) described the idea of nature study. Nature study is, fundamentally, “seeing what one looks at and drawing proper conclusions from what one sees; and thereby the learner comes into personal relation with the object” (Bailey, 1909, p. 30). Bailey noted the importance of personal connection to cultivate the spiritual and intellectual curiosity of the outdoors. This can best be explained through the analogy of a brook. Through imagery and metaphor, Bailey (1909) narrated how a brook can be used to describe the interconnected, awe-inspiring potential of outdoor appreciation. Bailey (1909) described a brook as such:

To my mind, one of the best of all subjects for nature-study is a brook. It affords studies of many kinds. It is near and dear to every child. It is an epitome of the nature in which we live. In miniature, it illustrates the forces that have shaped

much of the earth's surface. It reflects the sky. It is kissed by the sun. It is rippled by the wind. The minnows play in the pools. The soft weeds grow in the shallows. The grass and the dandelions lie on its banks. The moss and the fern are sheltered in the nooks. It comes one knows not whence; it flows one knows not wither. It awakens the desire to explore. It is fraught with mysteries. It typifies the flood of life. It goes on forever. (p. 45)

This quote can be used as an exemplar of nature worldviews as described by other environmental educators, philosophers, and authors who contributed to environmental education in the late 19th and early 20th century. Today, his idea of nature study inherently aligns to constructivist learning theory as well.

Bailey's seminal work on nature study was in response to the rural flight that occurred as a result of industrialization and urbanization (Dubois & Krasny, 2016). Individuals were trading farmlands, pastures, and their innate connection to nature for economic prosperity that large cities could offer. This idea was supported by Comstock's (1911) handbook on nature study. In her work, Comstock (1911) described the importance of hands-on learning that is necessary for students to connect to nature through nature study. The idea is predicated on specimen collection, care, and the use of field work tools such as scopes, lenses, field notebooks, and collection containers that kept living organisms alive. Furthermore, nature study is grounded in the idea of observation, connection, and thorough study of plant and animal identification and lifecycles (Comstock, 1911). Early environmental education contained these beliefs and encouraged outdoor education practices by teachers.

Environmental Education Includes Conservation

Disinger (2001; 2005) described the inclusion of conservation education to environmental education at the beginning of the 20th century when federal and state natural resource management agencies formed. Soulé and Press (1998) referred to the environmental politics of this time period as a polarizing dichotomy between conservation and preservation. Conservation efforts were controlled at state and federal levels and prioritized economically wise management of land and natural resources. Preservation was the responsibility of individuals to keep natural resources the way they are, all based on the best science available at the time. Soulé and Press (1998) were quick to point out that this differing worldview continues today “in the form of the polarity between anthropocentrism and ecocentrism” (p. 397). In other words, there were, and continue to be, conflicting ideologies as to how our natural resources should be managed. However, environmental education at the time incorporated both worldviews and each has a place in the development of pro-environmental behaviors (Disinger, 2001; Dubois & Krasny, 2016). There have been several prominent preservationists during the 20th century who have influenced the direction of environmental education.

Preservationists of the 20th Century

Well known works by Muir (1916), Leopold (1949) and Carson (1962) are used as exemplars for the preservationist movement of the 20th century and their influence on environmental education. John Muir’s walking adventures and journal entries have made him one of the most influential and prominent preservationists and environmental advocates to “encourage Americans to celebrate the aesthetic and spiritual value of wilderness, and to resist the ravaging commercialism that posed an ever-increasing threat

to America's wildlands" (Branch, 2001, p. 19). Aldo Leopold's writings and teachings centered on people's relationships to the land and their moral obligation to preserve it leading to a lifetime of positive environmental action (Goralnik & Nelson, 2011). Lastly, Rachel Carson's most famous work, *Silent Spring*, introduced a new generation to the detrimental effects of indiscriminate use of chemical pesticides, specifically dichlorodiphenyltrichloroethane (DDT), and the lasting implications of bioaccumulation and sustainable pest management. Griswold (2012) referred to Carson's work as popularizing modern ecology and introducing environmental activism during the environmental movement of the 1960s. The work of pioneer preservationists like Muir, Leopold, and Carson have established the need to both conserve natural resources as well as preserve the gifts Earth provides.

Addressing Environmental Issues Through Community

Pioneer work by conservationists and preservationists influenced environmental education to include pedagogies addressing the growing issue of pollution in the 1970s and 1980s (Dubois & Krasny, 2016). Hungerford, Peyton, and Wilke (2010) described how environmental education during this time lacked a concrete set of standards or uniformed pedagogical programming goals in secondary schools to address global pollution concerns raised by environmental scientists like McKibben (2006). At this time, there was no curriculum emphasizing the importance of citizens working both as individuals and as a community toward the issues affecting the well-being of all (Strapp, 1969). Strapp (1969) defined environmental education as a discipline that is "aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to

work toward their solution” (p. 34). Therefore, it was determined that environmental education lacked consideration of the environmental, social, and economic impacts of global issues in secondary curricula.

Strapp (1969) wrote extensively on the nature of community and the social responsibility of citizens to address the biophysical environmental problems. Environmental issues described by Strapp (1969) include pollution, the mismanagement of natural resources, overuse of pesticides, urban blight, and the dependency of fossil fuels and are best addressed through environmental education that encourages “responsible environmental behavior” (Hungerford & Volk, 1990, p. 259). However, at that time, environmental education did not incorporate methodology for teachers to address the social responsibilities of citizens (Hungerford & Volk, 1990). The challenge, according to these researchers, is the lack of direction in environmental education. Therefore, Hungerford and Volk (1990) were pivotal in defining early curriculum development and standards to give citizens ownership and empowerment to care for the environment. At this time, a superordinate goal of environmental education was written:

The superordinate goal of environmental education is to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment. (Hungerford & Volk, 1990, p. 263)

Furthermore, Hungerford and Volk (1990) delineated four subgoals of environmental education:

1. To provide learners with a foundation of ecological knowledge which leads to better decisions in regard to environmental issues.
2. To encourage awareness in learners of how individual and collective actions influence the quality of the environment.
3. To develop environmental knowledge and skills in a way where learners feel empowered to problem solve and investigate environmental issues.
4. Lastly, to encourage positive environmental action in learners.

The work by Strapp (1969) and Hungerford and Volk (1990) are grounded in the importance of teaching ecological principles, understanding environmental issues, and encouraging students to act. These components of environmental education laid the foundation for the introduction of sustainability to environmental education curriculum.

The Convergence of Environmental Science and Environmental Education

As previously indicated, early environmental science courses placed emphasis on nature study (Bailey, 1909; Comstock, 1911), preservationism (Leopold, 1949; Muir, 1916), and conservationism (Carson, 1962). Through foundational scientific knowledge and the acquisition of skills in the three main science disciplines, students develop an understanding of the natural world, contemporary environmental challenges, and global issues. Wals, Brody, Dillon, and Stevenson (2014) noted that environmental science has evolved to develop competitive scientists and engineers in a changing global landscape. Environmental education, on the other hand, fosters a duality of this environmental knowledge with changing behaviors of students through the constructs of values. Therefore, Wals et al. (2014) described the genesis of environmental education was in response to emergent environmental crises like food scarcity, malnutrition, and the loss of

biodiversity. Studies conducted by Fraser, Gupta, and Krasny (2015) support these findings and also conclude that the moral obligation of developing pro-environmental behaviors is needed to address common environmental crises and global issues.

Wals, Brody, Dillon, and Stevenson (2014) described how many of the desired outcomes of environmental education today are different from initial environmental education research. Previous research on environmental science focused on the linear relationship between knowledge, awareness, and attitudes to eventual pro-environmental behavior development and practices. Today, much more research is focused on enabling students to think critically, ethically, and creatively when approaching global issues, to make sound and informed decisions about global issues, and to act individually and collectively in ways to solve global issues sustainability and in equitable ways (Wals, Brody, Dillon, & Stevenson, 2014). Moreover, the worldviews and beliefs of individuals are extremely important if global issues are going to be challenged collectively. While environmental science provides insight into how learners understand natural systems, environmental education focuses on the social, economic, and environmental engagement of the public that is translated to meaningful action. This may be accomplished through teaching students how to critique their actions and ask, “What then?” (Orr, 1992). The “what then?” statement by Orr is at the center of the ecological literacy movement. The ecological literacy idea is fundamental to environmental education which is designed to “change the way people live, not just how they talk” (Orr, 1990, p. 50). For example, students can learn about resource management in an environmental science class, but environmental education pushes their knowledge to accept that values and ethics play a role in sustainable development.

Including ecological perspectives in a variety of social, economic, and environmental contexts is to be ecologically literate (Orr, 1992). Orr (1992) acknowledges that ecological literacy is rooted in nature study philosophy when he stated that ecological literacy is driven by the “sense of wonder, the sheer delight in being alive in a beautiful, mysterious, bountiful world” (p. 22). On the contrary, Orr (1992) also stated that the “darkness and disorder that we have brought to the world give ecological literacy an urgency it lacked a century ago” (p. 22). Therefore, ecological literacy begins at childhood where a sense of biophilia (Wilson, 1984) can be instilled while young students can appreciate the complexity of how their decisions and actions contribute to the degradation of Earth and apply stress to the limits of Earth’s resources.

As a result, Orr (1992) offered suggestions to environmental educators. First, educators must realize that all education is environmental education. When students learn to read and write critically about environmental topics, they become more versed in solving complex global issues. Secondly, environmental issues are complex and are not understood through a single lens. There are social, economic, and environmental considerations to global issues like climate change. Third, environmental education occurs through dialogue and conversation that acknowledge and accept differences of others. This is reminiscent of Block (2009) where individuals are invited to conversations and differences are celebrated. Fourth, students should be involved and participate in their own learning while they construct their environment knowledge. Fifth, environmental education should be conducted outdoors where diversity can be seen, heard, and felt. And sixth, environmental education should blend knowledge with sustainable practices where students practice what they learn. The above characteristics

of ecological literacy merge scientific knowledge with sustainable practices. When students learn how to bring an ecological perspective to every facet of their lives, the idea of global sustainability becomes that much more realistic once resource inequalities are addressed. Therefore, the primary research question becomes more relevant when determining how environmental education teachers integrate social justice themes in their classrooms.

Sustainability Concepts in Environmental Education

Le Grange (2013) argued that environmental education should be redirected to focus more on sustainability to address environmental deterioration. This shift emerged during the 1990s (Robottom & Stevenson, 2013; Sund, 2015). Robottom & Stevenson (2013) provided a clear definition of educating for sustainability:

The ultimate goal of the decade is that education for sustainable development is more than just a slogan. It must be a concrete reality for all of us - individuals, organizations, governments - in all our daily decisions and actions, so as to promise a sustainable planet and a safer world to our children, our grandchildren and their descendants ... education will have to change so that it addresses the social, economic, cultural and environmental problems that we face in the twenty-first century. (p. 125)

New fields like conservation biology, environmental economics, and environmental justice have provided some framework to environmental studies programs (Soulé & Press, 1998) and have strengthened the idea of ecological literacy as described by Orr (1990; 1992). These programs incorporate the environmental knowledge that predecessors stressed coupled with the community approach to managing global

environmental issues. As global issues like climate change, population growth, and food scarcity emerged, an educational approach was needed not only to address immediate concerns, but also to address sustainability (Colliver, 2017; Tilbury, 1995). Stern, Powell, and Hill (2013) reviewed several environmental education programs and studies published from 1999-2010 and determined programs that explicitly addressed real world environmental problems and stressed the importance of learner empowerment and cooperative group work had positive outcomes in student learning. Furthermore, Stern, Powell, and Hill (2013) reported that characteristics of successful environmental education programs “focused on specific places and issues, explicitly linking program content to students’ home lives, and/or explicitly provoking student reflection” (p. 601). This study is supported by Fraser, Gupta and Krasny (2015) who determined the importance of environmental learning and stewardship to advance community development through sustainable practices. These researchers concluded that the most important factor in environmental education is to teach people how to live sustainably. Anderson (2012) argued for using sustainability in the environmental education classroom to mitigate climate change specifically “education geared towards learning how to change lifestyles, economies, and social structure that are based on excessive greenhouse gas production” (p. 193). Sustainability is an important topic in environmental education and social justice, and it is a considerable topic in the Advancement Placement Environmental Science curriculum.

The first AP Environmental Science exam was administered in 1998. The genesis of the course was to explore the relationships between living things and to investigate and analyze the resulting global issues and environmental problems caused by both humans

and the natural world. According to Tierney et al. (2020), the AP Environmental Science curriculum aligns well with project-based learning (PBL) structured around how humans maintain Earth's sustainability. Tierney et al. (2020) referred to students as "decision-makers throughout the curriculum" (p. 77). PBL provides the opportunity for students to engage in the material while increasing understanding of complex environmental issues. The researchers note that oftentimes students feel pessimistic and hopeless while exploring global issues. Therefore, the AP Environmental Science curriculum is designed to increase engagement with data, visual representations, and writings for students to evaluate and propose solutions to the issues.

Environmental education has evolved immensely over the past 100 years based on the best science available. Environmental education continues to be fluid and incorporate new ideologies and practices. A constant, however, is the idea that students best learn about nature and develop pro-environmental behaviors by being immersed in it. Nature theory, conservation practices, and preservation all have roots in outdoor play and exploration. However, as science continues to identify, interpret, and delineate climate change data, the ideas of sustainability, social justice, and environmental justice have emerged and are examples where current environmental curriculum needs to evolve to continually develop pro-environmental behaviors in youth. A thorough literature review follows describing climate change science and the incorporation of social justice themes into contemporary environmental education curriculum.

The Science of Climate Change

Introduction

The purpose of this study is to determine how environmental science teachers incorporate social justice themes in their classrooms. The preceding section described the history of environmental education, but with growing global issues, specifically climate change, the environmental science curriculum has needed to change to incorporate social justice themes to foster pro-environmental behaviors in students (Howell, 2014; Kollmuss & Agyeman, 2002). The following section will briefly describe the science of climate change in order to illustrate the importance of social justice curriculum and the underlying purpose of this study.

A Brief Overview of Climate

Climate is different from weather. Shepardson, Niyogi, Roychoudhury and Hirsch (2012) succinctly described weather as the day-to-day observations of air temperature and precipitation while climate refers to the average weather, temperature, precipitation, and wind patterns over time. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) (2019) noted that climate reflects how weather behaves over the long-term whereas weather flux is experienced daily. The Intergovernmental Panel on Climate Change (IPCC) has stated that climate has changed based on human activities centered around economic and population growth, and that humans have been altering the climate since the industrial revolution (IPCC, 2014). The IPCC explicitly stated that “human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems” (p. 2).

Climate Change is Occurring

Humans have had a substantial impact on our planet's climate and ecosystems. It is now believed Earth is unofficially part of the Anthropocene epoch where humans have created lasting impacts on ecosystems for thousands of years through progressions in agriculture, technological advancements, and societal development. Through anthropogenic (Haluza-Delay, 2012) action, mass extinction of plant and animal species has recently occurred, oceans polluted, and the chemistry of the atmosphere changed (Stromberg, 2013). Specifically, Anyanwu and Le Grange (2018) confirmed findings by the IPCC (2014) and Few (2003) that impacts from climate change include extreme heat waves and drought, floods, intensive equatorial tropical storms, and wildfires. These weather events can be difficult for people in developing countries to overcome.

Many scholars and a growing number of politicians recognize the clear reality of climate change and the associated magnitude of the dangers to biodiversity and sustainability of life on Earth (Harari, 2018; IPCC, 2014). It is further agreed upon that anthropogenic climate change has been occurring due to the release of atmospheric accumulation of greenhouse gases (Gifford, Kormos, & McIntyre, 2011; Wynes & Nicholas, 2017). The two main greenhouse gases are carbon dioxide (CO₂) and methane (CH₄) released during the combustion of fossil fuels and deforestation (Shepardson et al., 2012). For billions of years, the earth has had systems in place to sequester carbon. This process is known as the carbon cycle. Oceans, plant matter, and soil all behave as carbon sinks, locking in and storing carbon for an indeterminate amount of time. Through organic cellular respiration, carbon changes form - locked in sugars and carbon dioxide gas which is used to drive photosynthesis. As plants and animals die, the carbon cycle

continues, and carbon is simply recycled or compressed deep underground in the form of oil, coal, and natural gas. Since the industrial revolution, humans have burned fossil fuels at an unprecedented rate, releasing this stored-up carbon in the form of carbon dioxide to the atmosphere. Pre-industrial revolution, the concentration of CO₂ gas in the atmosphere was determined to be 285 parts/million (ppm). In 2018, the amount of atmospheric CO₂ was determined to be 405ppm (Elliott, 2018). Understanding the carbon cycle is a key principle of climate literacy (Branch, 2019). Carbon cycling and sequestration is important for students to understand as these are direct links to human involvement in a changing climate.

Releasing carbon into the atmosphere has resulted in increased air and water surface temperature. Carbon, in the form of carbon dioxide and methane, act as a barrier, locking in the heat and light energies that are normally reflected back into Earth's upper atmosphere. As solar radiation strikes the Earth, much of that light and heat is reflected back and lost into space. However, these greenhouse gases prevent this process from occurring, essentially raising Earth's global surface temperatures slightly since the industrial revolution.

Climate Change Data

Recent studies have indicated the detriments of climate change on Earth's systems. International organizations such as the United Nations Intergovernmental Panel on Climate Change (2014), NCSE (2020), the Union of Concerned Scientists (2016), and Gonchar (2019) published scientifically based climate change information to describe the effects of climate change. Briefly, here is a summary of these works:

1. Atmospheric carbon dioxide concentration has risen to 405 ppm over the past 200 years.
2. Ocean surface temperatures have increased 1.5°F since 1860.
3. Sea levels have increased 8.9 inches since 1880.
4. Arctic sea ice is shrinking.
5. Oceans have become 30% more acidic causing coral bleaching events.
6. Surface temperatures have risen 1.2°C in the past 150 years.
7. 2018 was the hottest year on record with the greatest number of days above 90°F.

The above climate change detriments illustrate the effects of climate change on planet Earth. However, these events do not fully describe the social impacts climate change has on people and for those most marginalized.

Social Effects of Climate Change

Climate change has a negative impact on people and the social repercussions are profound. Levy and Patz (2015) detailed several global environmental and health concerns and noted that climate change may be “the defining moral issue of the 21st century” (p. 311). Specifically, these environmental and health consequences have severe repercussions that endanger the economic, social, and cultural rights as well as access to clean, safe food and water, shelter, health, and security of global citizens. As a result, people who are most vulnerable to these consequences of climate change include poorer people in developing countries, minority groups, people with diseases, and minorities (DeSchutter, 2012). This is further explained by Gross (2002) who described how the number and increased severity of natural disasters such as tropical storms, droughts, and floods affect those most marginalized. Poorer countries are less resilient, have more

difficulties recovering from natural disasters, and are more impacted by the corresponding diseases, like malaria and dengue fever, that break out from disruption in food supplies and sanitation (Thomas & Twyman, 2005). Furthermore, due to higher levels of vulnerability coupled with a lower adaptive capacity, developing countries tend to be even more reliant on fossil fuels and less concerned with sustainable practices and those lifestyle choices that ensure clean air and water for future generations.

Pro-Environmental Behavior Development

Introduction

A constant variable throughout the development of environmental education over the 19th and 20th century is the importance of teachers fostering pro-environmental behaviors among students (Disinger, 2005; Howell, 2013; Hungerford & Volk, 1990; Kollmuss & Agyeman, 2002). Furthermore, the severity and frequency of natural disasters such as tropical storms, floods, and drought appear to be increasing as climate changes and the atmosphere becomes more unstable (Few, 2003; Gross, 2002). Also, Thomas and Twyman (2005) reported that the literature overwhelmingly suggests that “the poorest and most vulnerable groups will disproportionately experience the negative effects of 21st century climate change” (p. 115). Yet, there is increasing international recognition that actions must be taken by all global citizens to examine practices and increase actions to mitigate climate change as a more holistic approach to sustainable development.

Semenza et al. (2008) suggested adaptation and mitigation to combat the disparity caused by climate change. Adaptation refers to preventative measures, while mitigation efforts focus on reducing carbon dioxide emissions. However, there are barriers that exist

for the development of these pro-environmental behaviors among people in developed countries - those people whose actions tend to exacerbate climate change the most. The following sections will examine those barriers to pro-environmental behaviors which prevent slowing the effects of climate change. Lastly, these barriers will be used to explain the pedagogical gap that exists in environmental education and frame the purpose of this qualitative study - to determine how environmental science educators integrate social justice themes in their practices to ultimately slow climate change.

Barriers to Pro-Environmental Behaviors

Heimlich and Ardoin (2008) along with Kollmuss and Agyeman (2002) described barriers preventing pro-environmental behaviors among individuals. Heimlich and Ardoin (2008) also discussed how these barriers exist in environmental education and noted how environmental educators tend to focus on behavioral outcomes “rather than the steps required to reach those outcomes” (p. 218). It is these steps that are often referred to as barriers, thus establishing the need for environmental education reform to understand how to overcome these barriers. Specifically, Kollmuss and Agyeman (2002) identified three main barriers to climate change action that environmental education teachers must address: individuality, responsibility, and practicality.

Individuality

Individual choices influenced by strong environmental concerns do not always translate to actions that minimize environmental impacts (Kollmuss & Agyeman, 2002). For example, environmental science students often use an ecological footprint calculator (Cordero, Todd, & Abellera, 2008) to calculate how individual choices impact shared

resources. A popular footprint calculator is provided by the Global Footprint Network (2020) which runs users through a variety of questions on personal consumption use.

The footprint calculator (Global Footprint Network, 2020) asks participants to answer questions on food choice and the amounts of different types of meat, dairy, and vegetable choices along with consumption frequency. Participants also reflect on clothing, electronics, and transportation choices before their data is calculated and displayed as the number of Earths needed to support the entire Earth's population based on their individual choices. According to the Global Footprint Network, the average footprint of an American citizen is 8.1 Earths with a corresponding gross domestic product (GDP) of \$52,319/person, whereas citizens of the Republic of Congo have a footprint of 0.7 Earths and \$408 GDP/person (Global Footprint Network, 2020). This footprint calculator can be used to illustrate the ecological impacts one individual has but does not necessarily translate into action.

It has been argued (de Groot & Steg, 2009; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014) that pro-environmental behaviors are cultivated through biospheric values (outdoor play and love of nature) which are encouraged by an ecocentric worldview centered on intrinsic value of all living things. However, studies by Howell (2013) and Howell and Allen (2019) have shown a shift in individual thinking. Specifically, Howell and Allen (2019) noted that people who sought to reduce their ecological footprint because of climate change concerns were "motivated more by altruistic concerns about impacts on poorer people than by biospheric concerns about the environment" (p. 815). In other words, people in this study reported how social justice

and fairness are motivating factors to understand how climate change affects marginalized individuals.

Another study supporting the results of Howell and Allen (2019) was conducted by Wolf, Brown, and Conway (2009) who reported that individuals tend to make responsible decisions to limit environmental impacts because of the apparent unfairness and feelings of guilt as poorer individuals suffer more from the effects of global climate change. It is noted that both studies highlighted the impacts of social justice responsibility. These studies showed that participants responded favorably to social justice concerns when global issues caused by climate change were highlighted. Previous studies such as Hungerford and Volk (1990) and Kollmuss and Agyeman (2002) reported the value only of individual biospheric concerns for pro-environmental behaviors. It was studies conducted by Howell and Allen (2019), Bouman and Steg (2019) and Cordero, Centeno, and Todd (2020) that placed emphasis on social justice responsibility to mitigate climate change and are exemplar works used to frame the research question: How do environmental science teachers describe their efforts to integrate social justice themes in their classrooms when teaching climate change?

Responsibility

Environmental science curriculum and textbooks are evolving to include more climate change science and examples of individual choices that can mitigate climate change. Wynes and Nicholas (2017) introduced data that included responsible choices individuals and communities could make to limit carbon emissions and reach the targets set by the Paris Agreement in 2015. These researchers concluded that responsible choices include having just one fewer child, living car-free, avoiding airplane travel, and eating a

plant-based diet. These are drastic measures and differ from other common recommendations to reduce carbon footprints by turning off lights, taking quicker showers, or purchasing more fuel-efficient cars (Buttigieg & Pace, 2013). However, drastic measures to reduce carbon footprints by following such responsible actions are not followed by most individuals who prioritize individual motivations versus society norms.

The groundbreaking study by Hines, Hungerford, and Tomera (1987) found that individuals with strong pro-environmental attitudes were more likely to engage in responsible pro-environmental behaviors. Furthermore, according to these researchers individuals who “felt some degree of personal responsibility toward the environment were more likely to have engaged in responsible environmental behaviors than were individuals who held no such feelings of responsibility” (p. 5). However, as noted by Kollmuss and Agyeman (2002) this study does not explain whether these pro-environmental behaviors came about through intentions or actual responsible behavior. Hence, Kollmuss and Agyeman (2002) emphasized the importance of altruism, empathy, and pro-social behavior and that responsible choices made by individuals do lead to pro-environmental behaviors and an awareness of the disparity between developing and developed countries (Thomas & Twyman, 2005). Again, specific, common methods for teaching these types of behaviorism and motivation are lacking in current environmental education courses.

In order for a society to become more sustainable, individuals must feel part of a society and act responsibly. Block (2009) wrote extensively about community and the importance of inviting individuals to the community by celebrating the voices and gifts of

all. The same can be said about environmental sustainability and social norms. According to Howell and Fielding (2019) if a person “does not believe that their actions on a day-to-day basis will affect the overall well-being or outcome of the entire community, then their lifestyle and values will not change” (p. 12). This statement is profoundly true in society and is a barrier to pro-environmental behaviors. Kinzig et al. (2013) argued that environmental behavioral changes to include more sustainable choices can only be implemented if societies change personal and social norms. It would be difficult to change social norms that include a plant-based diet, less air travel, and having fewer children when this is how our society has functioned for so long unless governmental policies are enacted. However, there are individuals that do understand the importance of climate change mitigation behaviors as described by the case study of Aitken, Chapman, and McClure (2011).

Aitken et al. (2011) described a major barrier to pro-environmental behaviors is powerlessness. This feeling, where an individual may be less likely to act environmentally responsible if they feel the rest of the community is not contributing equally, can lead to individuals making less responsible choices. Buttigieg and Pace (2013) noted that there is no single factor that is optimal for promoting pro-environmental activism as life experiences are different for all people. They noted that it is “clear that fundamental change in societal behavior requires more than just a few individuals acting on a voluntary basis - it requires society norms and rules that complement pro-environmental behavior” (p. 27). It is clear that society norms are a result of the complex social interactions between diverse individuals, and this should not be a barrier to the development of pro-environmental behaviors.

Practicality

Models used to predict Earth's climatic future and how the planet will continually respond to high levels of carbon dioxide differ (Gramling, 2020). However, recent data described by Gramling (2020) indicated the need to focus pro-environmental behaviors on sustainability and inclusive development through investment in education and health care. Sustainability, global population, and health expert Hans Rosling (2010) argued in his famous TED talk that an increase in childhood survival rates will slow down the global population growth rate. His data showed once systematic improvements in economics, education, and healthcare were addressed for individuals in developing countries, childhood survival rates improved, dramatically lowering the population growth rates. This notion, however, is predicated on global changes to involve learning to live in sustainable ways through the development of pro-environmental behaviors (Sund, 2015).

Baer et al. (2000) wrote extensively about the Kyoto Protocol and how industrialized nations must assist developing countries with technological improvements to energy solutions in order to be able to lower greenhouse gas emissions. In other words, in order to combat rising global CO₂ concentrations, developed nations must improve energy infrastructure for developing countries and move away from fossil fuel dependency. This idea of societal shifts in energy infrastructure breaks the old dependency of fossil fuels and introduces renewable energy to developing countries first. Gramling (2020) refers to this as "shared socioeconomic pathways" (p. 20) where developed countries like the US take the lead in organizing ways for developing nations to be energy independent and sustainable. Gramling (2020) argued that global

sustainability is achieved when “the world focuses on sustainability and inclusive development” (p. 20). Contemporary environmental educators like Strapp (1969), Hungerford and Volk (1990) and Pellow (2018) argued that sustainability is achieved through the inclusion of both biospheric and social justice themes in environmental education.

Conclusion

Pro-environmental behavior development in students is vital to the sustainability of Earth’s resources. People who tend to be affected most by environmental changes, specifically climate change, are those who work or live off of the land (Bullard, 1996; Pellow, 2018; Lambert, 2020). However, the development of pro-environmental behaviors is rooted in education. For example, nature study introduced young people to the outdoors through play and exploration. Conservationists and Preservationists introduced the idea of responsibly maintaining shared resources while a shift occurred in environmental education to incorporate ecological knowledge and sustainability practices during the 1970 and 1980s. Recently, literature has shown the importance of social justice to environmental education and the idea that people are motivated to improve their environment and the environment of others through a shared, common good (Howell, 2013). The following sections will introduce the reader to social justice education and the current practices in environmental education.

What Do Science Standards Say About Climate Change

Introduction

Environmental education is a call to action against climate change and other contemporary issues and problems that face the global population (Beach, Share, &

Webb, 2019). In a further attempt at delineation, Hodson (2010) claimed that most environmental problems arise as social justice issues whereas race and ethnicity, gender, and social class are the “major factors determining who controls and benefits from the businesses and institutions that cause environmental degradation and who experiences the adverse impact” (p. 200). Beach, Share, and Webb (2019) supported by Hodson (2010) indicated that typically the poorest countries and poorest people have less resources to defend themselves from the effects of climate change. In other words, affluent countries and communities have the resiliency and therefore the responsibility to mitigate the unfairness and unbalanced effects of climate change to the global population. This mitigation process begins in the classroom by creating a sustainable future with a shift towards global equity (Lowe, 2004). To fully understand how environmental science teachers incorporate more social justice themes in their classrooms, current environmental science standards and practices must be explored.

National Research Council Report

In 2012, the National Research Council (NRC) released a conceptual framework report to establish guidelines and science standards for voluntary adoption by any state reworking district and state standards to address science education reform demands (NRC, 2012). This framework, in essence, had three parts. Bybee (2017) outlined these three parts: a vision for science education, the content for science and engineering education, and the integration of content, implementation, equity, and guidance for the Next Generation Science Standards. The NRC framework provided a means of coherence in K-12 science education and to make science more accessible. Specifically, the NRC strived to define practices when articulating its vision and goals for K-12 science

education to include educating “all students in science and engineering and providing the foundational knowledge for those who will become the scientists, engineers, technologists, and technicians of the future” (NRC, 2012, p. 12). A foundational aspect of the framework is not only rooted in the high standards and academic goals for all students but also the declaration that all students, regardless of race or socioeconomic status have adequate opportunities to learn and to achieve at a high level.

Next Generation Science Standards

The Next Generation Science Standards (NGSS) were completed in April of 2013 and served as a continuation of the work conducted by the National Research Council. The NGSS were the first set of standards that directly addressed anthropogenic impacts on the environment (Clark, Sandoval, & Kawasaki, 2020). The NGSS describes three distinct and equally important expectations to learning science and how each dimension works with the other two (Bybee, 2014; Pruitt, 2017). The standards represent performance scientific practices, core ideas, and crosscutting concepts to foster deeper understanding of natural phenomena as opposed to rote memorization. To fully understand the need for social justice practices in environmental education, first the reader must realize how the NGSS were developed and how the three core areas came about to address future scientists and science educators.

Ford (2015) expanded on work by Bybee (2014) and Krajcik, Codere, Dahsah, Bayer, and Mun (2017) when he stated that science and engineering practices go beyond traditional inquiry methods of the past (Ford, 2015). The NGSS, therefore, incorporates scientific practices, core ideas, and crosscutting techniques to help students understand concepts and integrate understanding of connected ideas. Krajcik et al. (2017) reported

that the NGSS have “fundamentally changed the focus of science education” (p. 158). Rather, the NGSS calls for a shift in learning content through inquiry to more of a holistic approach where students build and apply knowledge through practice and connect ideas across all science disciplines through crosscutting concepts. These methods help students build understanding by asking questions, refining problems, investigating, and analyzing data, constructing models, and justifying conclusions based on data and evidence to explain natural phenomena (Ford, 2015; Krajcik et al., 2017).

The summative evaluation of the NGSS conducted by Krajcik et al. (2017) shows the changes being made to science education today to include topics on sustainability (McLaren, 2003). Developing core ideas and knowledge, practicing like a scientist or engineer, and fostering crosscutting concepts to show relationships between science disciplines all work in conjunction for the development of scientific dispositions of students in a way where students learn to seek and build their knowledge. Nevertheless, Krajcik et al. (2017) related the importance of teacher training and professional development so teachers feel supported in the classroom and provide an effective curriculum. Furthermore, Egger, Kastens, and Turrin (2017) made explicit how human impacts on Earth’s systems is one of the core ideas stressed in the NGSS but this topic falls under the Earth and Space Sciences within the NGSS “despite widespread agreement that sustainability (and even sustainability science) is necessarily inter-and/or transdisciplinary” (p. 170). In other words, the NGSS teach more about sustainability rather than for sustainability. In their research, Egger, Kastens, and Turrin (2017) discovered that future teachers engage sustainability topics through their ecological behaviors and the connections they make within their communities. Therefore, it is

necessary for environmental education to incorporate social justice themes in the classroom to address sustainability issues within communities. However, the NGSS avoided the social and political aspects of climate change and action and left teachers to figure this out on their own (Clark, Sandoval, & Kawasaki, 2020). This remains a significant challenge of the NGSS and teaching the social, economic, and environmental impacts of climate change (Pruitt, 2017).

Climate Change in the Science Classroom

Introduction

Climate change, and the resulting impacts, continues to be one of the most significant issues facing all global citizens (Anderson, 2012; Branch, 2019; IPCC, 2014). However, global climate change has served as a catalyst to a commitment to educational reform and the continual development of the NGSS to address social and political aspects of climate change (Clark, Sandoval, & Kawasaki, 2020). Clark, Sandoval, and Kawasaki (2020), expanding on the work of McKenzie and Bieler (2015), noted how teachers tend to be reluctant to engage students in social, economic, or political topics around climate change as they lack the educational background to sufficiently explain the science behind climate change. Furthermore, the NGSS failed to fully address the social aspects of climate change and to make climate change explicit in state standards (NCSE & TFN, 2020). The following sections will address these issues and continue the argument for social justice inclusion in environmental science classrooms to mitigate climate change.

Effective Climate Change Education Today

A recent report published by UNESCO (2019) indicated climate change education is occurring in 95% of all countries globally with 50% occurring in formal school

settings. The report concluded that the most common approach to teach climate change was through awareness programs. However, as previously mentioned, research by Howell and Allen (2017) and Bouman and Steg (2019) concluded that pro-environmental behaviors are more deeply developed when global issues are framed through a social justice approach. However, research by Monroe, Plate, Oxarart, Bowers, and Chaves (2019) found that of all the climate education lessons conducted by teachers from their study, none focused on any social justice-oriented outcomes. Rather, Monroe et al. (2019) noted two emerging themes from their study on effective climate change education strategies: making climate change personally relevant and meaningful for learners while designing educational lessons that engage learners.

Making climate change personally relevant includes embedding topics through local community case studies (Monroe et al., 2019). Monroe et al. (2019) recommended educators build relevancy by addressing local issues in order to make such a nebulous, distant issue like climate change more personally relevant. An example of this is recent wildfires in California and the west coast of the United States. Out of control, overabundant wildfires are indicative of climate change (Beach, Share, & Webb, 2019). Currently, California is experiencing disastrous wildfires, fueled by dry conditions, strong winds, and excessive summer heat where four out of the five historically largest wildfires on record burned in the summer of 2020. (Pierre-Louis & Schwartz, 2020). Those suffering from the life lost, property damage, and disruption from the wildfires have a personal connection to the effects of climate change and can illustrate the social, economic, and environmental impacts of climate change issues. These lived experiences are moments Monroe et al. (2019) as well as Beach, Share, and Webb (2019) indicated

where environmental science educators can make climate change impacts more relevant to students' lives. Furthermore, they argued that climate change issues, like wildfires, affect those who are poorer or generally marginalized and who are less resilient to climate change disasters. Therefore, the social justice issues ought to be included and utilized more in science and environmental classrooms.

Making climate change topics more relevant through lived experiences, a social justice framework, and the resulting impact on people is not enough (Monroe et al., 2019). Rather, environmental science teachers must engage their learners through experiential lessons, inquiry, and constructivist approaches when teaching climate change (Jacobson, McDuff, & Monroe, 2015). Through worksheets, simulations, and lab activities, Monroe et al., (2019) characterized engagement strategies as ones where “learners were working together, sharing ideas and observations, and coming to new understandings” (p. 800). Here, the social interaction is stressed where learners work together, problem solve together, and work collaboratively to solve global issues and challenges of climate change. Most effectively, Monroe et al., (2019) made a cogent argument for teacher driven, deliberate discussions which help learners better understand their own and their peers' viewpoints and knowledge construction of climate change. These deliberate discussions make explicit the importance of social interactions to address misconceptions of climate change and to design and implement community actions to address climate change. These deliberate and explicit interactions are driven by social justice themes in the science classroom and create more scientifically and environmentally literate students.

Using Literacy to Teach Environmental Science

The Next Generation Science Standards lists eight essential practices essential for science students: asking questions while defining problems, developing and using models, planning and doing investigations, analyzing and interpreting data, using math and computational skills, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information (NGSS Lead States, 2013). Friedrich, Brown, and Howlett (2019) suggested incorporating Moje's (2008) principle of disciplinary literacy when constructing scientific knowledge through the engagement of scientific texts. Disciplinary literacy is defined as the confluence of knowledge, content, experiences, and skills merged with the ability to read, write, and listen critically within different secondary disciplines (Moje, 2008). Relating this specifically to science, Friedrich, Brown and Howlett (2019) describe the benefits of teaching students to think like scientists through engaging in texts to read, write, and interpret data like scientists. To meet the needs of the NGSS framework, students must begin to think like scientists and be immersed in critically analyzing and discussing texts and data on climate change.

McLaughlin and DeVogd (2004) defined critical literacy as a tool to help students read and understand texts and media by broadening their views as they investigate literature from multiple perspectives. Critical literacy is also a means to understand social structure, history, and cultures (Simpson, 1996). Scientific critical literacy, similarly, aims to prepare students to think and function as responsible global citizens capable of taking socially responsible action on global issues like climate change (Vieira & Tenreiro-Vieira, 2016). Friedrich, Brown, and Howlett (2019) provide an

example of how the critical analysis of scientific texts, data, and the media can occur using a case study at a high school in Dearborn, Michigan with teachers and students engaged in scientific and popular texts to explore the anthropogenic causes of climate change. Students analyzed data sets to understand recent trends. Students studied diagrams of the biogeochemical cycles to understand how humans have increased the natural greenhouse effect, the mechanisms that drive climate change. Lastly, during their unit on climate change, students viewed the 2016 documentary *Before The Flood*, a popular film about global climate change and the efforts made to combat it. Throughout the unit, texts, data, and media this case study activity provided students the opportunity to critically analyze and critique what they have learned (Friedrich, Brown, & Howlett, 2019).

A key component of scientific literacy and the NGSS framework is that students must see themselves as readers and learners of science (Bybee, 2017; Friedrich, Brown, & Howlett, 2019). This is evident in the case study from Dearborn, Michigan at Fordson High School where students worked collaboratively on most tasks during the class period. At the beginning of the school year, the entire class generated a list of strategies for approaching and interpreting sets of data when reading charts and graphs through a critical lens. Then, within small groups, students employed these strategies to construct their learning and connections to climate change mechanisms and explanations. Friedrich, Brown, and Howlett (2019) explicitly stated that “each time they approach a new text, say a graph of temperature change or a diagram of the carbon cycle, they review, add to, and reflect on the list of strategies for unpacking it” (p. 24). This list of strategies included circling keywords, identifying purposes, making connections, identifying

patterns, and questioning patterns. This entire process happened within their classroom community and highlighted the importance of collaboration, supported the eight scientific practices of the NGSS investigations, as well as strengthened the argument of employing social justice practices in environmental education.

National Center for Science Education Survey

Branch (2019) provided a current update on the states who have adopted science standards to include climate change education. Currently, 36 states have adopted standards that acknowledge human activity has resulted in climate change. Of these, 20 states have also adopted the Next Generation Science Standards which includes global climate change as part of a disciplinary core of the Earth and Space sciences. The remaining 14 states, however, show the polarization of this topic in the United States. Five - Alabama, Florida, Georgia, Oklahoma, and Virginia - have state standards that mention anthropogenic climate change as simply a possibility. Next, four of the remaining states - Montana, Nebraska, Ohio, and Pennsylvania - fail to mention anthropogenic climate change. Lastly, five states - Mississippi, South Carolina, South Dakota, Texas, and West Virginia mention anthropogenic climate change but present it as a matter of scientific debate. Fortunately, Branch (2019) determined that the “arc of state science standards is clearly bending toward including climate change as the scientific community understands it” (p. 15). In other words, science teachers are teaching more and more about climate change.

In 2015, the National Center for Science Education (NCSE) in conjunction with Pennsylvania State University conducted a national survey of 1,500 science teachers in secondary public schools to determine what about climate change and how climate

change was taught in schools (Branch, 2019; Plutzer et al., 2016). The results were impressive, but also identified areas of concern. Plutzer et al. (2016) reported several key findings:

1. Climate change is taught in approximately 75% of public schools.
2. Teachers are including essential topics in their curricula including greenhouse gas emissions, carbon cycle, and consequences of climate change.
3. Teachers are linking science content to positive global action.
4. Students are receiving mixed messages about climate change; 30% of teachers emphasized the scientific consensus of human activities while 70% introduce the ambiguity of natural causes being behind recent global warming.
5. Many teachers rated their expertise on climate change science as below their normal science discipline. This indicates that teacher training on climate science is deficient.
6. Many teachers are interested in professional development in climate sciences. However, only two-thirds of teachers surveyed see human activities as the primary cause of climate change.
7. Few teachers report pressure to teach or not to teach the human causes of climate change.
8. Climate change education is complicated. Undergraduate programs need to offer more programming on climate science, teachers in the classroom need access to sound professional development, teacher training programs need to acknowledge the politicization of climate change, and educational professionals must be vigilant to thwart efforts to introduce denial into classrooms.

From the results of the NCSE/Penn State survey, Branch (2019) made the logical argument that teachers are unprepared to teach climate change even though it is taught in 75% of public schools. Specifically, Plutzer et al. (2016) reported mixed messages occur at schools, as roughly 30% of teachers reported that global warming is likely due to natural causes and another 12% reported not emphasizing human causes at all even though 97% of climatologists attribute climate change to human causes. However, as indicated by the report, a majority of teachers are enthusiastic about and are open to learning about climate change, pedagogy, and professional development opportunities. The NCSE is cognizant of these desires and is currently working to draft a “pioneer set of lesson plans specifically geared to help science teachers present the scientific consensus on climate change effectively” (Branch, 2019, pp. 16-17). These lesson plans are developed by master teachers and professional climatologists alike to debunk the five foremost misconceptions students are likely to encounter about climate change (Branch, 2019, Plutzer et al., 2016):

1. Scientists disagree about climate change and human activity.
2. The scientific models of climate change are inaccurate and unreliable.
3. Climate change is natural and cannot be stopped with changes in human activity.
4. Extreme weather is not a function of climate change.
5. There is no plausible solution to climate change.

Furthermore, Plutzer et al. (2016) provided explanations for the mixed messages occurring at schools. First, teachers feel pressure from families, community leaders, and school administrators not to teach climate change. Secondly, teachers may lack adequate knowledge and training to teach about climate change. Lastly, teachers may be

uninformed of the overwhelming scientific agreement on climate change causes. These areas lend themselves to opportunities for professional development which will provide teachers with increased chances to improve their climate change curriculum and disseminate effective climate change lessons and activities. A deficiency in their findings is the link to the social and environmental justice movements.

Conclusion

There are systemic obstacles to effectively teaching climate change in the United States (Branch, Rosenau, & Berbeco, 2016). Making the content more relevant and engaging is necessary for students; however, a strong background in climate sciences and practices is also needed in science teachers. The layering of critical scientific literacy in curriculum fosters growth within students to begin thinking and practicing like scientists tasked to confront global issues like climate change. The NCSE/Penn State survey was pioneering, the first of its kind to articulate what climate science is being taught, how it is taught in conjunction with the NGSS, and the challenges facing climate change educators (Plutzer, et al., 2016). The survey was obtained by Glenn Branch, the deputy director of the National Center for Science Education and was used to inform the survey for this research study. It is noted that the participants of the NCSE/Penn State survey are Earth, biology, chemistry, and physics teachers. Advanced Placement Environmental Science was not included. However, the survey was not intended to consider how climate change education incorporates and supports the social justice movement and studies and works by Bullard (1993;1996), Howell (2013), Pellow (2018) and Spitzman & Balconi (2019) that link the importance of climate change mitigation to social justice concerns. The following sections will commence with a review of social justice in secondary schools

and eventually end with a discussion on environmental justice to support the research question of this study: How do environmental science educators integrate social justice themes in their classrooms to mitigate climate change?

Teaching for Social Justice in Science Classrooms

Introduction

The concept of social justice has become increasingly more common and therefore more complex to define in education (Spitzman & Balconi, 2019). However, social justice in education is characterized by respectful communication and inclusivity. Nieto and Bode (2018) offered a current definition of social justice as:

A philosophy, an approach, and actions that embody treating all people with fairness, respect, dignity, and generosity. On a societal scale, this means affording each person the real - not simply a stated or codified - opportunity to achieve to her or his potential and full participation in a democratic society by giving each person access to the goods, services and cultural capital of a society, while also affirming the culture and talents of each individual and the groups or groups with which she or he identifies. (p. 8)

Teaching for social justice narrows Nieto and Bode's definition of social justice as it requires individuals to confront the educational inequalities that exist among ethnicity, gender, sexual orientation, and social class (Bell, 1997; Cho, 2017). Hackman (2005) defined social justice education as students taking an active role in their own education while teachers create "empowering, democratic, and critical educational environments" (p. 103). Research suggests that educators have increased efforts to promote equity and social justice in education across all contexts such as educational experiences, gender,

ethnicity, and socioeconomic equalities (Dover, 2013; Francis, Mills, & Lupton, 2017). Darling-Hammond (2017) argued the importance of acknowledging and confronting inequalities in schools when she wrote:

But to really deal with the issues we are facing and to create a more equitable and just education system and society, we must do more to confront and change the aspects of institutionalized racism and intolerance that are embedded in our schools. (p. 133)

The following section will discuss five frameworks of teaching for social justice (Hackman, 2005): content mastery, critical analysis, social change, reflection, and awareness of multicultural groups and will be used to argue for doing more than Darling-Hammond positioned. Lastly, these frameworks will provide the basis for including social justice in environmental education by confronting the inequalities that exist between shared resources and responding to global issues created by climate change. Each framework (Hackman, 2005) will be defined in terms of social justice teaching (Dover; 2013) and then context will be provided in terms of environmental education and engagement in climate change mitigation (Wolf, 2011).

Content Mastery

Content mastery is the first framework of effective social justice education (Hackman, 2005). Hackman wrote “without complex sources of information, students cannot possibly participate in positive, proactive social change” (p. 104). In other words, as students learn content, they foster critical skills through problem solving, investigation, and dialogue with their classmates on both local and global issues (Dover, 2013). Mastering content also allows students to have meaningful and engaging conversations

about critical global issues addressed in environment education classrooms. Wolf (2011) referred to this idea as ecological citizenship while developing pro-environmental behaviors. Not only do citizens show knowledge of environmental problems but also a concern for others and a willingness to act and create change. This is accomplished through content mastery and a sense of community to equally distribute all of Earth's resources and understanding how local and global communities are affected by a topic like climate change.

Tools for Critical Analysis

Content mastery is not sufficient for teaching social justice as students must also become critical thinkers. Hackman (2005) urged educators to provide opportunities for students to employ critical analysis and careful consideration of inequalities to develop deeper knowledge and application skills when confronting global issues. Critical thinking is the "process by which we consider perspective, positionality, power, and possibilities with respect to content" (Hackman, 2005, p. 106). Dover (2013) referred to critical thinking more as democratic education where students are guided through deeper thinking scenarios to develop analytical skills to identify areas of systemic inequity. Both of these approaches require students to be responsible for their actions and be active participants in their community while learning to question, judge, and reflect on what they read, write, and see in the media. Wolf (2011) called this idea public engagement to mitigate climate change. According to her, knowledge about climate change is not sufficient to change behavior. Rather, citizens must be ready to engage in, reflect on, and critically understand emotions in order to create behavioral changes. Drought and diminished crops leading to hunger is an example of this. Massive droughts brought on

by climate change can lead to both economic and social consequences including starvation and death. Critically analyzing the science behind drought should include the social and economic repercussions.

Tools for Social Change

Social justice education is not only ancillary to critical thinking but also fosters hope within students. Hackman (2005) described the foundation of social justice education includes feelings and attitudes of hope and positive, creative energy as opposed to complacency, despair, and hopelessness. Dominant groups may feel stuck in their privilege, while marginalized groups may feel the frustration of oppression. Dover (2013) referred to this as being culturally responsive where teachers are trained to respond to social and educational inequity and identify areas where students struggle when critically analyzing a dilemma or global issue. This framework of teaching for social justice aligns itself well with environmental education as most global topics elicit emotion with students (Bouman & Steg, 2019). However, students respond differently to these situations based on their positionality. Wolf (2011) referred to this as civic engagement with climate change. She noted the importance of knowledge of climate change science, but knowledge is not sufficient for change. Rather, Wolf (2011), supported by Naoufal (2014) and Howell (2014) stated the importance of empowerment when confronting climate change. In her study, participants reported feeling hopeless, helpless, frustrated, and angry in response to climate change. Furthermore, her participants reported feeling compassion towards those affected by the impacts caused by climate change. Guilt was an emotion commonly associated with climate change. Wolf (2011) noted that many participants were “insightful regarding the underlying context of poverty and inequality

in developing countries and believed that these countries suffer disproportionately from the burden of climate change” (p. 126). Teaching for social justice education requires socially responsive teachers who acknowledge the emotional and social impacts of global issues while making the culture of the classroom inclusive for all students (Dover, 2013).

Tools for Personal Reflection

Hackman (2005) argued that the extent to which most educators engage in social justice education is limited to content mastery, critical analysis, and social education. Therefore, she urges teachers to reflect critically on themselves and the “personal qualities that inform their practice” (p. 106). Dover (2013) agreed when she described critically self-reflective teachers as those “willing to examine and reflect upon their own social, educational, and political identities” (p. 5). Self-reflective practices help students and educators understand their positionality and how individuals approach different groups of people. This awareness helps students challenge and change behaviors or moments of inequalities when they are observed (Dover, 2013). The lack of self-reflection, therefore, encourages passivity and powerlessness and tempers openness to change. Wolf (2011) referred to the importance of self-reflection when engaging in climate change behaviors. As indicated previously, Wolf (2011) stated that climate change knowledge is not enough to mitigate climate change. In fact, a pragmatic approach of acknowledging detrimental behaviors, examining practices, and understanding individual levels of engagement all aid in pro-environmental behavior engagement. Wolf (2011) did note limitations to her study and further research is required to qualify the levels of engagement and the sense of individual agency to engage in climate change mitigation. This process could include self-reflection.

An Awareness of Multicultural Groups

The last tool for effective teaching for social justice education recommended by Hackman (2005) and Dover (2013) involves understanding multicultural group dynamics. Both students and the teacher bring their unique gifts (Block, 2009) to the classroom and teachers must acknowledge these and facilitate ways to promote them. An acute awareness of the cultural and social identities that both students and teachers have is needed. Multicultural dynamics awareness lends itself to creating a student-centered learning environment. However, Hackman (2005) warned a student-centered approach “should not be used as a means for members of traditionally marginalized groups to be placed in the position of educating the dominant group members in the classroom” (p. 108). Rather, each student should be the agent of his or her own education where the teacher is willing to bring awareness to differences and celebrate the gifts and perspectives that all students bring to the discussion. Wolf (2011) referred to the multicultural dynamics awareness where individuals combine both knowledge and affect when confronting issues brought on by climate change. As indicated in the previous section, research points towards an increase in emotional guilt, frustration, and compassion in individuals for those who are more affected by the impacts of climate change. Wolf (2011) argued in her study that by addressing the fears, acknowledging the diversity of global citizens and the array of positionalities and abilities to withstand global impacts, and feeling affirmed in one’s own identity, her participants had a “sense of urgency about acting on climate change, even if they [the participants] did not identify or feel personally affected by local climate change impacts” (pp. 127-128). In other

words, by understanding the cultural, social, and economic differences between people, her participants felt a greater sense to engage in pro-environmental behaviors.

Conclusion

The preceding section presented current practices to increase social justice education awareness in classrooms while relating these frameworks to engaging behaviors for climate change. While the framework tools presented are certainly not exhaustive, they serve as a bridge between social justice and the inequitable burden placed on those who cannot withstand impacts brought on by climate change. Therefore, the need to incorporate social justice themes into the environmental education curriculum is critical. The remaining sections in this chapter will continue to frame global issues through a social justice lens before concluding with a review of the environmental justice movement to show why this topic is important and why the research question: *how do environmental science teachers incorporate social justice themes in their classrooms?* is so important.

Using Social Justice to Frame Global Issues

Introduction

Incorporating social justice themes in environmental education curricula has never been more relevant than it is today. Dealing with global issues and providing students with a more equitable and just educational system occurs when resources are equally allocated, students have an equal opportunity to learn, the social and emotional needs of students are met, and personalized relationships between teachers and students are created and nurtured (Darling-Hammond, 2017). This phenomenological, qualitative study is not about teaching for social justice. However, this study centers on how

environmental science teachers incorporate social justice themes into their teaching. As Howell and Allen (2017) and Bouman and Steg (2019) indicated, equal importance is given to social justice themes when developing pro-environmental behaviors in students. The following section uses current literature to present ways social justice intersects with pressing global issues commonly found in environmental science curriculum.

Teaching Tolerance

As previously indicated, the Next Generation Science Standards (NGSS) were established to encourage students to think and practice like scientists throughout all scientific disciplines. This includes topics in sustainability and climate change education (Ford, 2015). Bang, Brown, Barton, Rosebery, and Warren (2017) explored the potential shift in science education toward a more equitable and engaged learning experience for all students through the NGSS. Specifically, Bang et al. (2017) stated that “as a society, we have historically failed to provide meaningful, challenging, and engaging science education for students from historically underserved communities (p. 33). When this occurs, students from these communities tend to experience science classes as disconnected from their lived experiences, their questions about natural phenomena, and concerns of their own personal communities. Therefore, the organization Teaching Tolerance has published a broad range of free materials for K-12 teachers both in print and online (Shuster, 2018). Specifically, Teaching Tolerance has published a revised set of social justice standards to serve as a common language and organization that teachers may use to incorporate social justice themes in their classrooms (Teaching Tolerance, 2020). These standards are broken into four domains: identity, diversity, justice, and action while each domain is broken down further into five anchor standards (Spitzman &

Balconi, 2019) (See Appendix A for a complete list of domains and anchor standard statements). Each of these domains will be explored below and framed with current global issues typically addressed in Advanced Placement environmental science curriculum and connected to the environmental justice movement: the environment, food production, energy acquisition, and climate change (Pellow, 2018).

Identity

The identity domain of the social justice standards published by Teaching Tolerance refers to the social identities developed by students and fostered by teachers (Spitzman & Balconi, 2019). Within this domain, teachers are provided the tools and experiences needed to help students develop a positive and healthy self-esteem, recognize differences in others, and learn to recognize traits of a dominant culture while concomitantly learning to identify their own. Most importantly, students learn to navigate their own identity in a variety of settings (Teaching Tolerance, 2020).

The associated issues of biodiversity loss and green space inequalities are connected to Teaching Tolerance's identity domain. Urban area development includes residential and mixed residential zones that allow for residential and industrial buildings to coexist (Taylor, 2014). Taylor (2014) noted that mixed zones tend to be more affordable and therefore lead to a higher population density near environmental hazards. Residents living in these high environmental hazard areas cannot or do not move because of financial constraints. Bullard, Mohai, Saha, and Wright (2008) noted that people of color comprise 56% of the population living in neighborhoods with mixed residential and industrial zones. In other words, Bullard et al. (2008) stated that environmental factors can negatively affect the social and economic conditions for minorities and low-income

individuals leading to chronic health conditions such as asthma, diabetes, and high blood pressure. Similarly, due to uneven demographic zones, minority and low-income communities have far less access to green spaces like parks, forests, and gardens when compared to affluent, dominant communities (Wolch, Byrne, & Newell, 2014).

Therefore, Teaching Tolerance (2020) promoted the idea of identity where teachers acknowledge the different lived experiences of minority students when incorporating social justice themes in classrooms.

Diversity

Along with identity, Teaching Tolerance (2020) stresses the importance of diversity when including social justice themes in classrooms. Through diversity efforts, students will learn to be comfortable with others who are both similar and different through respectful language, curiosity, empathy, and connection. Most importantly, by acknowledging diversity, students will learn to “examine diversity in social, cultural, political, and historical contexts rather than in ways that are superficial or oversimplified” (Shuster, 2018, p. 3). In their study, Spitzman and Balconi (2019) stressed ways that teachers ensure that multiple perspectives are welcomed and respected through dialogue and the integration of prior lived experiences.

Environmental educators can become more attentive to the diverse sense-making connections students are making in the classroom (Bang et al., 2017). Bang et al. (2017) wrote extensively on equitable learning in science classrooms and described three principles teachers use to allow teachers to engage learners from multiple backgrounds. These are: to attend to, listen to, and acknowledge sense-making repertoires of students, to support sense-making repertoires and experiences as critical tools for engagement, and

lastly, to engage students in understanding of scientific practices through their own community, values, and practices.

This is most evident when framed through the issue of food security (Pellow, 2018). Access to adequate, nutritious food is a right for all individuals. However, according to the USEPA (2017), 11.1% of Black and Hispanic American households experienced food insecurities. Globally, developing nations are more likely to experience food insecurities and the negative effects of climate change compared to developed nations. The widespread impacts of climate change on food production are complex, geographically isolated, and heavily influenced by socioeconomic conditions (IPCC, 2014). Therefore, environmental science teachers must be aware of and attentive to minority students when introducing global food insecurities as some students may have a strong personal connection to this topic. However, acknowledging, supporting, and engaging in sense-making skills can contribute to scientific understanding and problem-solving techniques to overcome global issues like food insecurities magnified by climate change.

Justice

The next domain in the Teaching Tolerance (2020) repertoire of social justice standards is justice. Justice, according to Teaching Tolerance, refers to the recognition and acknowledgment of stereotypes, inequalities, biases, and power and the effect they have on the relationships of people (Spitzman & Balconi, 2019). Spitzman and Balconi (2019) described how these characteristics lead to a missed opportunity for connection in the classroom when teachers failed to recognize when insensitivity to diversity or hidden biases and stereotypes were present. What is recommended through the Social Justice

standards by Teaching Tolerance (2020) is a mindful effort to have explicit lessons that promote action against injustice.

The global issue of energy acquisition can be used to model Teaching Tolerance's (2020) domain of justice. There is a fuel poverty, or fuel insecurity, that exists in the United States (Reames, 2016). Nearly 37 million American homes suffer from this form of energy poverty with the inability to afford heating or cooling services. Reames (2016) pointed out that the inability to properly heat during the winter or cool in the summer leads to "detrimental mental and physical health impacts, including death, for vulnerable populations like children, the elderly, and minorities" (p. 549). Furthermore, there exists a global inequity as to who has access to fossil fuel resources, the amounts of greenhouse gases emitted, and renewable energy infrastructure research (IPCC, 2014). In other words, developed countries burn more fossil fuels to meet electricity and transportation needs while emitting more carbon dioxide gas when compared to developing nations who are more reliant on biomass for fuel. This inequality, as to who has access while polluting more, only exacerbates the issue that developing countries and minority populations feel the effects of climate change more than those who contribute more (IPCC, 2014). Action is needed to change this, and it can be done through the implementation of social justice themes in the environmental science classroom to foster change and mitigate the issues brought on by climate change.

Action

The final domain of the revised Teaching Tolerance (2020) social justice standards is action. Action consists of empathy and the responsibility of individuals to stand up to exclusion, prejudice, and injustices. The call to action encourages students to

speak up with courage, make decisions based on principles, and take a stand against biases, stereotypes, and injustices in their everyday lives. Most importantly, action refers to a collective, community-based response as the most effective response to injustices. The call to action to mitigate climate change is, without a doubt, a major theme of this dissertation.

As previously determined, the scientific community is mostly in agreement that humans have caused climate change and the resulting major global impacts (USEPA, 2017; IPCC, 2014). Furthermore, lower income communities, as well as developing nations, are much more likely to feel the burden of climate change threats like flooding, major hurricanes, and drought due to inadequate housing infrastructure (Bullard, 1993, 1996; USEPA, 2017; Lewis, 2016). Moreover, people living on coasts and small equatorial island nations will feel the effects of sea level rise and flooding from strong tropical storms. Subsistence farmers in developing nations will not be able to adapt quickly enough to grow food in droughts due to climate change. Lastly, communities with inadequate healthcare systems will not be able to react to catastrophic effects of climate change like heat waves, storms, or waterborne diseases (EPA, 2017; IPCC, 2014). While this dissertation is not a summative, nor exhaustive, review of all global impacts, it serves as a call to action for environmental science teachers to incorporate social justice themes in their curriculum to mitigate climate change.

Conclusion

Framing global issues through the Teaching Tolerance social justice standards serves as an example of how teachers can incorporate social justice themes in the curriculum while teaching the effects of climate change on marginalized communities

and developing countries. The 2016 NCSE/Penn State climate change survey, the four domains of Teaching Tolerance (2020) social justice standards along with work completed by Spitzman and Balconi (2019) have guided the survey and interview questions of this qualitative, phenomenological study and will be expanded on in Chapter Three. Nonetheless, the work reviewed thus far in Chapter Two culminates with a review of the environmental justice movement and the grounded theory that unequal sharing of global resources has led to a poor quality of life for some who often feel the burden of climate change the most. Therefore, it is clear that action and change is needed to include more social justice themes in environmental education to understand how to overcome these inequalities.

The Environmental Justice Movement

Introduction

The National Science Teacher Association (NSTA) described social justice in the science classroom where students recognize their own agency to engage in social justice projects informed by the sciences (NSTA, 2020). Here, they argued that justice-oriented science teachers promote the knowledge and experiences of students and their communities through sense-making activities, making decisions using scientific knowledge, practicing science and engineering, and learning focused on commitments to human dignity while fostering respect and a sense of responsibility for all living things (NSTA, 2020). Works by Hackman (2005), Dover (2013) and both the NGSS Lead States (2016) and Teaching Tolerance (2020) have a similar approach and guidance to their social justice teaching approaches. A unifying theme centers on equal access to shared resources and a global sense of community. This phenomenon is aptly referred to as

environmental justice. The following sections will define environmental justice and offer a discourse on how it aids environmental science teachers to integrate social justice themes through an examination of the 2020 United Nations Sustainable Development Goals Report.

What is Environmental Justice?

Environmental justice (EJ) is a difficult term to define (Agyeman & Evans, 2004). While some definitions include sustainability or simply refer to environmental justice as the inequity in the burden of environmental toxins and hazards, others have expanded the term to include the underlying reasons for the inequity in the first place (Schlosberg, 2013). Bullard (1996) described environmental justice as a framework that “all people and communities are entitled to equal protection of environmental and public health laws and regulations” (p. 495). Dr. Robert Bullard is often considered the father of environmental justice and has been a leading figure and voice of the climate crisis that “affects everyone everywhere as climate change is the number one global environmental justice issue of the twenty-first century” (Lewis, 2016, pp. 1-2). Most recently, Pellow (2018) offered a succinct, yet comprehensive definition of environmental justice:

The EJ movement is largely composed of people from communities of color, indigenous communities, and working-class communities who are focused on combating environmental injustice, racism, and gender and class inequalities that are most visibly manifested in the disproportionate burden of environmental harm facing these populations. For the EJ movement, the battle for global sustainability cannot be won without addressing the ecological violence imposed on vulnerable

human populations; thus social justice is inseparable from environmental protection. (pp. 4-5)

In other words, the social justice movement is intertwined with the environmental justice movement. Agyeman, Bullard, and Evans (2003) described how environmental justice activists often become “politicized towards sustainability” (p. 329). For example, those individuals tend to shift from arguing against developing landfills in low-income communities to campaigning for a collective reduction in waste produced. Championing environmental rights tends to intertwine with sustainable practice advocacy.

Sustainability and equal access to clean air, water, and resources will never be fully attained until social injustices are addressed.

Creation of the Environmental Justice Tenants

The First National People of Color Environmental Leadership Summit was held on October 24th, 1991 in Washington DC in response to a growing grassroots movement that began during the Civil Rights Movement in the 1960s which aimed to overcome environmental racism (Bullard, 1993). Most notable was the Memphis sanitation workers strike of 1968 involving Dr. Martin Luther King where sanitation workers, mostly Black men, were protesting the inequality of working conditions (Bullard, 1993). These workers were striking for better wages, improved working conditions, and fair treatment like a place to change clothes or shower after a shift. This strike for equal treatment was the first national recognition of the environmental justice movement. Another catalyst for the environmental justice movement was the 1982 nonviolent sit-in protest against a plastic landfill in North Carolina. The site of the landfill was a predominately Black and poor county. Approximately 500 environmental and civil rights activists were arrested while

national media coverage ensued. Although the landfill went forward, this occurrence brought national attention and scrutiny, and raised questions of how many diverse communities were harmed by hazardous wastes (Bullard, 1993).

At the First National People of Color Environmental Leadership Summit, 17 principles of environmental justice were developed to guide the work of environmental justice leaders. These principles (See Appendix B) guide the work of the environmental justice movement and affirm equal and fair access to all of Earth's resources. Furthermore, the principles of the environmental justice movement work towards global sustainability and show the need for social justice inclusion in environmental classrooms. This is evident when examining the sustainability work by the United Nations.

Why Environmental Justice is Important Today

Identifying and addressing issues of social justice and equity in education has been gaining momentum since the civil rights movement (Philpot, 2015) yet more has to be done. As noted earlier in Chapter Two, Colliver (2017) emphasized how climate change negatively impacts global economies, societies, and the environment. Moreover, climate change science is readily available but the extent to which teachers are using resources available is unknown (Colliver, 2017; Fraser, Gupta, & Krasny, 2015). There is still a disconnect between what is known about climate change education and what is taught in schools. Since climate change has environmental, economic, and social implications of sustainability, climate change education should reflect this complexity (McKeown & Hopkins, 2010). The environmental justice movement has provided context to reaching global sustainability and thinking globally (Gough, 2012). Sustainable societies will only begin to emerge when they reach higher levels of social,

economic, and political equality within their societies. Bullard, Mohai, Saha, and Wright (2008) revisited Robert Bullard's 1987 report on toxic waste and waste. Their work continued to expose the detrimental effects that environmental hazards have on marginalized and poorer communities. Bullard et al. (2008) definitively concluded that the environmental justice movement continues to be relevant and necessary when they stated that:

Many of the environmental injustice problems that disproportionately and adversely affect low-income, and people of color communities could be eliminated if current environmental, health, housing, land use and civil rights laws were vigorously enforced in a nondiscriminatory way. Many of the environmental problems facing low-income persons and people of color are systemic and will require institutional change, including new legislation. However, government alone cannot solve these problems and the support and assistance of concerned individuals, groups, and organizations from various walks of life are needed. (p. 407)

In order to reach this level of co-activism between the environmental justice movement and sustainability, action is required in environmental classrooms to promote moments of social justice in the curriculum. Agyeman, Bullard, and Evans (2003) wrote extensively that the challenge of governments is to recognize how environmental justice is connected to sustainability policymaking. More specifically, equity and justice are cornerstone qualities of sustainable communities. Therefore, the purpose of the research study is equally relevant today to describe how environmental education teachers integrate social justice themes in their classrooms and strive for sustainable development.

The Sustainable Development Goals Report by the United Nations

The work for the Sustainable Development Goals Report (SDGs) began in 2015 to address the social, environmental, and economic demands of sustainability and to improve the lives of people everywhere and was revised in 2020 (United Nations, 2020). The report lists 17 sustainable development goals targeted for the year 2030 and also contains explicit methods to overcome the setbacks brought on by the COVID-19 pandemic (United Nations, 2020). This comprehensive report links both the social and environmental justice agendas to “end poverty and set the world on a path of peace, prosperity and opportunity for all on a healthy planet” (United Nations, 2020, p. 2). The 17 SDGs outline ways to transform the financial, economic, and political systems that govern our global societies as well as guarantee the human rights of all in the future.

The Sustainable Development Goals report positions itself to offer guidance to global sustainable development. However, very little attention has been given to guiding teachers and environmental educators to incorporate these goals and the vague targets in classrooms for the equitable and sustainable well-being of all (Biermann, Kanie, & Kim; 2017; Costanza, Fioramonti, & Kubiszewski, 2016). Costanza et al. (2016) noted how these sustainable goals are the first in history to include all 193 UN member countries working together to reach a more sustainable future while opening the door for future innovative work to reach them. The research of this dissertation work argues that social justice themes are needed in environmental science classrooms to reach a more sustainable future.

The Sustainable Development Goals Report highlights many of the same global impacts that are magnified by climate change and addressed by some environmental

science curriculum based on the frameworks from NGSS (NGSS Lead States, 2013).

While not written congruently, both the NGSS and the SDGs have similar outcomes of creating global, sustainable citizens who have access to shared resources and strive to reduce inequalities. These are also tenants of the environment justice movement. Figure 2.1 below is a representation of the 17 goals for 2030 aimed to transform the world (United Nations, 2020):



Figure 2.1: Sustainable Development Goals of 2030 by the United Nations

The sustainable development goals constructed by the United Nations will also serve as a resource for the survey and interview questions of this qualitative study.

Conclusion

The nascent environmental justice movement, inspired by Dr. Robert Bullard, called for environmental equality while acknowledging the intersection of race, gender,

and class with the environment (Lewis, 2016). Through the work of civil rights pioneers, the environmental justice movement is a contemporary, grassroots local movement that has evolved from addressing toxic environmental conditions suffered by minority communities to an expansive global paradigm for justice, equal rights, and action. Lewis (2016) noted that Robert Bullard remains hopeful when he said, “there is indeed reason to maintain hope since young people are not only aware but also willing to take action” (p. 2). This action, coupled with the social justice standards from Teaching Tolerance (2020) and the revised Sustainable Development Goals of the United Nations (2020) have strengthened the environmental justice movement and have framed this qualitative study that is aimed at understanding how environmental science teachers incorporate social justice themes in their classrooms.

Chapter Two Summary

Chapter Two presented the comprehensive argument for the integration of social justice themes in the science classroom. Overwhelmingly, the scientific community agrees that climate change has resulted from anthropogenic causes. The burden of the detrimental effects of climate change are placed more on minority communities and developing nations due to economic and social constraints. However, the National Research Council and the Next Generation Science Standards have begun addressing anthropogenic causes of climate change and increased the importance of sustainability. Studies by Howell (2013) and Kollmuss and Agyeman (2002) have placed the importance of social justice as vital to the development of pro-environmental behaviors and sustainability practices. Therefore, the initiatives by Teaching Tolerance and the United Nations were used to frame global issues and the incorporation of social justice

practices in education and have helped to ground this research question: *Do environmental science teachers report the use of social justice themes in their classrooms? And, if so, how do environmental science teachers integrate social justice themes in their classrooms?* Chapter Three will provide the data collection rationale for this qualitative, phenomenological study as well as a detailed account of data collection methods and procedures.

CHAPTER THREE

Methodology

We abuse land because we see it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect

-Aldo Leopold, *A Sand County Almanac*

Overview of the Chapter

Chapter Three describes the research paradigm, the research design, and the methodologies used to determine how environmental educators use social justice themes in their classrooms. As previously stated, studies by Howell (2013), Howell & Allen (2017) and Wolf (2011) have shown the importance of social justice in the development of pro-environmental behaviors of individuals. Chapter Three describes the research methodology used to determine how environmental science teachers who self-report using social justice themes in their class do just that. Furthermore, Chapter Three presents why a phenomenological, qualitative research design was most appropriate for the data collection process for this study to answer the primary and secondary questions, respectively: How do environmental science educators integrate social justice themes in their classrooms, and how has environmental education evolved to incorporate climate change education?

Introduction

As described in Chapters One and Two, this research sought to contribute to the field of environmental education aimed at mitigating global climate change by explicitly linking social justice themes and environmental education. More specifically, the research question asked *how do environmental science educators integrate social justice themes in their classrooms? Additionally, how has environmental education evolved to incorporate climate change education?* These questions are best answered through

qualitative research. A global perspective was desired as climate change is a global concern. Therefore, a phenomenological approach was applied and participants were selected from the Advanced Placement Environmental Science (APES) Facebook group. Maxwell (2013) described the importance of personal goals when developing research questions, and the research questions are grounded in personal experience and personal contributions to the evolving nature of environmental education to include social justice themes.

Explanation of the Research Paradigm

To determine how environmental science teachers incorporate social justice themes in environmental education curriculum, a qualitative study was conducted using a phenomenological study approach grounded in a constructivist research paradigm (Creswell, 2007; Hatch, 2002). McMillan and Schumacher (2010) described a distinguishing characteristic of qualitative research where “behavior is studied as it occurs naturally” (p. 321). Furthermore, Creswell (2007) noted qualitative studies as an approach for “exploring and understanding the meaning individuals or groups ascribe to a social or human problem” (p. 4). The topic of social justice in environmental education aligns itself nicely with qualitative studies. Several exemplar studies (Howell, 2013; MacFall, 2012; & Wolf, 2011) used qualitative studies to demonstrate how environmental education has evolved to incorporate climate change studies to develop pro-environmental behaviors. These researchers wrote extensively of the importance of surveying science educators directly. Howell (2013) and Howell and Allen (2019) described how in-depth interviews added to new understandings of the values, motivations, and routes of people developing environmentally friendly lifestyles.

Therefore, studies by both Howell (2013) and Howell and Allen (2017; 2019) were used to frame the study survey of this research.

Constructivist Paradigm

A constructivist paradigm, or world view, posits a perspective aligning well to qualitative research. Creswell (2007) described the goal of constructivists is to “rely as much as possible on the participants’ views of the situation being studied,” (p. 8). Data collection methodologies utilize open-ended questions which allow participants the opportunity to share their views through narratives, interpretations, and reconstructions of their lived experiences or experiences with the phenomenon being studied (Hatch, 2002). The phenomena in this research study is to determine how environmental science teachers utilize social justice themes and is best done through qualitative research allowing participants the opportunity to describe their own lived experiences in the classroom.

Qualitative Research

Qualitative research, particularly qualitative interviews, is grounded in understanding the daily lived experiences from the participants' own perspectives (Brinkmann & Kvale, 2015; Hatch, 2002). This is best done when conducted in the participant’s field such as a classroom or school (McMillan & Schumacher, 2010). McMillan and Schumacher (2010) discussed the importance of the role of a qualitative researcher and how roles can change from an outsider perspective to an insider one throughout the interview process. This flexibility allows for this study to be conducted in natural settings with rich narrative descriptions from the participant point of view and

classroom experiences as opposed to statistical analysis of generalizable results in quantitative design.

Briefly, it should be acknowledged why a qualitative methodology was used instead of a quantitative research design. Fink (2017) noted the close, personal connections between the researcher and respondents that qualitative studies afford. Research tools used to conduct this phenomenological study include a survey and in-depth interviews. To fully determine how teachers integrate social justice themes in their classrooms required close, personal connections made during the interview process. Qualitative research allows for the more open-ended questions and responses desired during the interview process as opposed to closed-ended questions and hypotheses utilized by quantitative research studies (Creswell, 2007). Fink (2017) also discussed validity, researcher bias, and selection bias issues that can arise when conducting qualitative interviews between researcher and participants. Most importantly, it should be noted that I teach environmental science and incorporate my own social justice curriculum throughout all themes during the school year. These biases will be further discussed in Chapter Five.

Explanation of the Research Design

For the purposes of this qualitative research study, a phenomenological research design was used to determine how a small group of environmental science teachers incorporate social justice themes in their classrooms. McMillan and Schumacher (2010) described phenomenological studies as those that describe the “meaning of lived experience” (p. 24). Likewise, Brinkmann and Kvale (2015) noted how phenomenological studies aim to understand social phenomena from the participants own perspectives. As a research design, case study contributes to the knowledge of

“individual, group, organizational, social, political, and related phenomena” (Yin, 2009, p. 4). While this research is not identified as a case study, there is value in studying the AP Environmental Science Facebook group as a whole.

Phenomenology

As a research method, phenomenological studies are classified as a qualitative research design. Creswell (2007) described how phenomenological approaches are based on the experiences of individuals and how these experiences impact everyday life. Fernandez (2016) added to this and described phenomenological studies as those that strive to articulate the structure of human existence while acknowledging biases. Lastly, van Manen (2015) defines phenomenology as the firsthand accounts that individuals experience when dealing with a phenomenon. All of these definitions and descriptions of phenomenology have led to utilizing this research design in this study. Sund (2015) described her qualitative study and extensive interview protocol to describe teacher experiences in environmental and sustainability education. She concluded that teachers reported an emotional response to sustainability. Direct, pointed interviews were the mechanism for her findings.

Understanding how environmental science teachers incorporate social justice themes aligns with a phenomenological approach. The lived experiences of environmental educators are important and providing them a voice in the development of environmental education curricula changes is needed. As described in Chapter Two, there is a gap in the literature describing the importance of social justice when developing pro-environmental behaviors. Leading examples of current research by Howell and Allen (2017) and Spitzman and Balconi (2019) indicated the importance of social justice when

individuals are making critical decisions about environmental choices while Sund (2015) described her experiences working directly with teachers during the interview process to unpack their lived experiences. This qualitative research study provided individuals the opportunity to describe their lived experiences about incorporating social justice themes in their classrooms.

Exploring my research question, *how do environmental science educators integrate social justice themes in their classrooms* through phenomenological research has provided insight into specific methods and strategies through multiple, global perspectives gathered from the research participants on Facebook. These methods and strategies, gleaned from in-depth interviews, have global implications that can be shared with other environmental science educators who desire to expand classroom offerings, labs, and activities that frame global issues through the incorporation of both biospheric experiences (the love of nature) and social justice themes of altruism and community. Creswell (2007) described phenomenological research as a design where “the researcher describes the lived experiences of individuals about a phenomenon as described by the participants” (p. 14). This phenomenological research unpacked the experiences of environmental science teachers to explain how social justice integration occurs in their classrooms.

Setting

Randolph (2009) stated the goals of a phenomenological study is to understand the essence of the lived experiences of a group of people. Therefore, the setting of this phenomenological research study occurred through an online global Facebook group. This group was established as a collaborative group within Facebook for environmental science teachers to share and discuss current topics and resources for the Advanced

Placement Environmental Science exam. This group was chosen for two very specific reasons. First, this group is truly global as members include teachers from across the globe. This research was designed to sample a broad range of environmental science teachers to determine how social justice themes are integrated in curriculum. Secondly, this group was chosen for the sheer size of the participant pool. As of spring of 2020, more than 6000 teachers are part of this group, and numerous posts occur throughout any given day. Therefore, this setting was chosen for exposure to a vast amount of people working directly with AP Environmental Science students.

Participants

As previously indicated, the setting and participants came from the AP Environmental Science Facebook page which has been chosen for its global reach and shared vision for an exhaustive and representative pool of participants (Randolph, 2009). Initially, a survey was posted to the Facebook page and participants voluntarily completed it. At this point, responses were anonymous. Next, participants were asked on the survey if they would be interested in participating in follow up interviews with the researcher. If participants selected yes, they were prompted to provide contact information. At this point, the survey was no longer anonymous and participants were contacted to complete online interviews. Being a global community, interviews were conducted over the Internet, coded, and analyzed through inductive coding methods.

Institutional Review Board (IRB) Process Overview

Upon completion of the proposal meeting with the dissertation committee and the inclusion of required changes, the IRB application and consent forms were drafted and submitted to Hamline University's review board. After one revision, the IRB application

and the survey and interview consent forms were approved on January 5, 2021 at which time data collection was permitted to begin.

Research Tools

Both an online survey and interviews were used to determine how environmental science educators integrate social justice themes in their classrooms. Surveys, according to Fink (2017), are “information collection methods used to describe, compare, or explain individual and society knowledge, feelings, values, preferences, and behavior (p. 2). Similarly, interviews, especially phenomenology qualitative research interviews, strive to understand the meaning of phenomenon of a participant’s lived world (Brinkmann & Kvale, 2015). The survey for this qualitative study was conducted online through Facebook. Due to their ease and capacity to reach more participants, the use of online surveys has increased dramatically in recent years (Revilla & Hohne, 2020). Both surveys and interviews provided insight to understand the phenomenon of integrating social justice themes into environmental science curriculum by members of the AP Environmental Science Facebook group page.

Explanation of the Survey

As directed by the research question, how do environmental science educators integrate social justice themes in their classrooms, the participants in this study were current or past environmental science classroom teachers who volunteered to complete a survey posted to the AP Environmental Science Facebook group. According to Fink (2017), oftentimes surveys are included as part of a larger study. In this case, qualitative interviews followed up on survey respondents. A cross-sectional survey design (Fink, 2017) was used where data was collected at a single time within the large Facebook group. The survey was primarily used to determine if AP Environmental Science teachers

reported using social justice themes in their classrooms and to identify potential teachers to participate in follow-up interviews.

The survey was conducted electronically using Google Forms and was informed by two recent published works. First, the survey was informed by the 2016 climate change survey conducted by the NCSE and Penn State (Plutzer et al., 2016) on the challenges of teaching climate change. Second, the survey was informed by Howell and Allen (2017) and their research examining the significant life experiences, motivations, scientific knowledge, and values of climate change educators. Administering surveys electronically provides data analysis in real time where data can be automatically entered into Excel Spreadsheets and databases (Fink, 2017). Revilla and Hohne (2020) concluded that online surveys should take no longer than 20 minutes for respondents to complete with an ideal range lasting 10 to 15 minutes. A link to the survey was posted to the global Facebook page on January 8, 2021. Although the survey was not tested with a pilot survey, the intention of the researcher was to have the survey take approximately 10 minutes to complete. The survey began with an applied consent form where participation was contingent upon their agreement with the provided consent (Appendix D).

Participants who agreed to the survey were allowed to continue while the survey ended for participants who disagreed.

The survey utilized ordinal scales for their ease of use and interpretation by the researcher (Fink, 2017). A simple 5-point Likert scale was used for the forced responses. The 5-point Likert scale ranged from 1 (strongly disagree) to a 5 (strongly agree) while a neutral choice was provided for each question. Upon the completion of the survey,

participants were invited to provide their email address for the opportunity to participate in a follow-up interview with the researcher.

The survey was posted to the AP Environmental Science Facebook group four times total. The first post occurred on January 8, 2021. While Fink (2017) recommended a target of 50% return rate, this number is not realistic given the unknown number of educators who check the Facebook group regularly. Furthermore, due to the nature of Facebook, as more posts are added daily, older posts get pushed down. As a result, the survey was posted three additional times to attract more participants. The survey had a total of 40 participants and the results will be discussed in Chapter Four.

Explanation of the Interviews

Brinkmann and Kvale (2015) compared interviews to the “development of everyday conversations” (p. 350). Similarly, Adams, Jones, and Ellis (2015) described how the insights acquired from talking with people through autoethnography research can “deepen and complicate our own stories” (p. 55). Therefore, interviewing environmental science educators was the primary research tool to determine how social justice themes are utilized in environmental science classrooms.

The semi-structured, in-depth interview process was informed by Brinkmann and Kvale (2015) and Hatch (2002) where the researcher established the interview protocol and prepared a set of guiding questions to generate data. Brinkmann and Kvale (2015) described semi-structured, qualitative interviews:

This kind of interview seeks to obtain descriptions of the interviewees’ lived world with respect to interpretation of the meaning of the described phenomena. It comes close to an everyday conversation, but as a professional interview it has a

purpose and involves a specific approach and technique; it is semi-structured - it is neither an open everyday conversation nor a closed questionnaire. (p. 31)

The semi-structured, in-depth interview questions were informed by the responses to the survey completed by volunteers from the AP Environmental Science Facebook group. In-depth interviews are helpful when detailed information about the lived experiences of individuals is required (Boyce & Neale, 2006). In-depth interviews, sometimes referred to as intensive interviews (Charmaz, 2006), allow researchers to explore lived experiences more deeply than what surveys can simply afford. In-depth interviews, as a result, allow participants the opportunity to share their own experiences in their own words through a variety of viewpoints (Brinkmann & Kvale, 2015).

Upon completion of the survey, participants were encouraged to provide an email address if interested in follow-up interviews. A total of 14 individuals provided contact information and all were contacted to participate in the follow-up interview. From this, eight participants responded and the interviews began on January 25, 2021 over Zoom. Due to the COVID-19 global pandemic, online interviews were selected to mitigate any contact between the researcher and participant. Salmons (2015) discussed the importance of in-depth online interviews and building trust and rapport when conducting synchronous interviews online. Therefore, participants were then contacted via email again to reaffirm interest in participating in an in-depth interview, to schedule the interview, and to read and sign the consent form which included information about the Zoom call being recorded for transcription posterity. The process for conducting the in-depth interviews entailed planning, developing the questions, conducting the interviews, analyzing data, and making conclusions (Boyce & Neale, 2006). Considerations informed

by Brinkmann and Kvale (2015) were also implemented to keep questions brief, simple, and open-ended, whereas Salmons (2015) remarked online interviews ought to include a scholarly context and exchange of honest insights between the researcher and participants. Therefore, the questions were provided before the start of the interview in hopes of a scholarly conversation where the participants offer their own perceptions, understandings, and experiences regarding the research questions.

Insofar as the research topic is social justice in environmental education, the interview questions were created to allow participants the opportunity to describe their experiences with social justice in their classrooms. Follow-up questions were also used. Follow-up questions, or probes, requires an interviewer to “have an ear for the interview theme and a knowledge of the interview topic, a sensitivity toward the social relationship of an interview, and knowledge of what he or she wants to ask” (Brinkmann & Kvale, 2015, p. 165). To put it succinctly, a researcher needs to be actively listening during an in-depth interview to collect data (Hatch, 2002).

Data Analysis Methods

The research question was addressed through a qualitative research paradigm using grounded theory to analyze the data. Maxwell (2013) discussed the basic principle of qualitative research is “data analysis should be conducted simultaneously with data collections” (p. 236). This allowed for a richer interview process as questions were drafted in response to survey results as conclusions emerged from the survey. Maxwell (2013) stated that qualitative analysis falls under three main categories: coding and thematic analysis, narrative analysis, and memos and displays. This research study relied on inductive coding, or in other words, grounded theory.

Grounded Theory

Hatch (2013) defined theory as a “set of concepts whose proposed relationships offer explanation, understanding, or appreciation of a phenomenon of interest” (p. 5). Grounded theory, similarly, is the construction of theory through the systematic collection of data. While phenomenology describes the meaning of a phenomenon, grounded theory attempts to generate a theory behind that phenomenon. Specifically, grounded theory is “a qualitative research design in which the inquirer generates a general explanation of a process, action or interaction shaped by the view of a large number of participants” (Hatch, 2013, p. 63). In this study, inductive coding was used to theorize how environmental science teachers use social justice themes in their classrooms.

All eight interviews were recorded through Zoom and subsequently transcribed at the end of each interview. The next step involved inductive coding of the transcribed interviews where categories started to emerge. Maxwell (2013) noted that categories emerge from the analysis of transcribed interviews while Charmaz (2006) indicated that categories emerge from decisions based on the views, values, beliefs, and assumptions of the researcher. As a result, any conclusions made by grounded theorists are “suggestive, incomplete, and inconclusive” (Creswell, 2007, p. 66).

A two-step process to coding the data in this qualitative study was informed by Saldaña (2013) to utilize both emerging categories through memo writing and central categories theme analysis. Saldaña’s (2013) work supports Charmaz’s (2006) belief of the importance of memo writing. Memo writing is used to reflect on emerging categories and subsequently is used to inform central, main categories of what the data is showing

so proper conclusions can be made. Memos can be brief comments in the margins, theoretical ideas recorded in journals, to full essays (Maxwell, 2013). Either way, memos help researchers record thoughts on paper which can be used to inform coding categories early on in the process. Specifically, memo writing “is a crucial method in grounded theory because it prompts researchers to analyze their data to develop their codes into categories early in the research process” (Charmaz, 2006, p. 188).

Grounded theory, as directed by Charmaz (2006) and Saldaña (2013) allowed for categories to be informed by both the survey and interviews. Maxwell (2013) suggested reading through all survey results, interview transcripts, audio recordings, and memos written before any initial coding and developing categories emerge from the data. Therefore, memo writing was used to guide the researcher during this process. Ideas and thoughts changed constantly throughout this process as categories emerged or were revised. Charmaz (2006) noted that memo writing should be similar to a brainstorm session where notes are written quickly without edits. These memos, subsequently, were then edited, revised, and grouped together as clear and evident categories emerged. As more data was categorized, themes and theoretical insights became clearer. Charmaz (2006) referred to this point as the saturation point of theoretical sampling where theory begins to emerge from careful data organization into categories and themes. At the saturation point, the researcher is developing theoretical insights to see all possibilities, making all connections, and asking all questions that the data contains. As noted by Charmaz (2006) grounded theory is not necessarily a linear process, rather a cyclical and iterative process that requires the researcher to constantly look back at emerging categories and revise emerging theory.

Chapter Three Summary

The research question - “How do environmental science teachers integrate social justice themes in their classrooms?” was examined using a qualitative research paradigm for this phenomenological study employing grounded theory methodology. Surveys informed by Fink (2017) and interviews informed by Brinkmann and Kvale (2015), Creswell (2007), and Maxwell (2013) were conducted. From these surveys and interviews, significant categories emerged from the data that informed new theories to address the research question and the central phenomena. Chapter Four is dedicated to reporting these findings.

CHAPTER FOUR

Results

Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves.

-Carl Sagan, *Pale Blue Dot*

Overview of the Chapter

The purpose of this phenomenological qualitative study was to determine how social justice themes are utilized in environmental education. Specifically, the primary and secondary research questions are:

Primary Question: How do environmental science educators integrate social justice themes in their classrooms?

Secondary Question: How has environmental education evolved to incorporate climate change education?

Both an online survey as well as qualitative interviews were conducted with members belonging to the Advanced Placement Environmental Science Facebook group. A total of 40 educators participated in the survey and 14 individuals provided contact information for the interview portion of this study. All 14 were contacted and eight of those individuals agreed to be interviewed. Chapter Four will describe the demographics of the interview participants as well as the grounded theory approach utilized to memo write, construct categories, develop emerging theories, and describe the theory to ground conclusions made to address the research questions. To help the reader stay focused, Chapter Four is organized into two parts. The first part describes the survey results and subsequent analysis, while the second part reviews the results and analysis of the

interviews. Chapter Four concludes with a thorough report of the theory gleaned from the grounded theory methodology approach.

Reporting of the Survey Results

Introduction

The online survey was posted on January 8, 2021 and concluded on January 25, 2021. During this time period, the survey link was posted four times to the AP Environmental Science Facebook group and a total of 40 participants completed the survey through Google Forms. As described in Chapter Two, the survey was informed by both the NCSE/Penn State climate change survey where approximately 1500 Earth, biology, chemistry, and physics teachers completed the survey and research conducted by Howell and Allen (2017). All participants of this study identified as AP Environmental Science teachers. As Fink (2017) noted, electronic surveys provide instant data that is easily imported to spreadsheets for analysis which was the case in this research study. The survey contained six different sections, and each section will be unpacked completely using Charmaz (2006) memo writing procedures to determine emerging theories and theories concluded. The sections are: attitudes and emotions concerning the environment, teaching and curriculum, teaching about climate change, motivation to teach about climate change, social impacts, and personal values. Demographic information regarding teaching experience and number of years teaching environmental science were also collected and analyzed below. A thorough review of the data and emerging theories are provided within each of the six sections.

Upon completion of the survey data analysis the following theories emerged: AP Environmental Science teachers do teach climate change, essential topics of climate change are part of the curriculum, and social justice themes are included in their teaching.

Survey Demographics

As previously mentioned, little demographic data was collected for the survey participants except the total number of years teaching and the total number of years teaching AP Environmental Science. At the onset of the data collection stage, the researcher did not feel it was important to collect gender or location data for the study. However, this may be a design limitation and will be discussed further in Chapter Five. The total number of years teaching as well as the number of years teaching APES was collected and shown in Table 4.1 below.

Table 4.1: Total number of years teaching as well as number of years teaching APES

	First Year # (%)	2-5 years # (%)	6-10 years # (%)	10-15 years # (%)	15+ years # (%)
How long have you been teaching?	2 (5.00)	3 (7.50)	6 (15.0)	11 (27.5)	18 (45.0)
How long have you taught/been teaching AP environmental science?	6 (15.0)	15 (37.5)	10 (25.0)	6 (15.0)	3 (7.50)

According to Table 4.1, a strong majority of the survey participants have been teaching for a total of 10 or more years while a minority have been teaching less than 10 years. On the contrary, a majority of the participants have been teaching APES for fewer than 10 years. Therefore, a majority of survey participants have experience teaching other science

disciplines beyond just AP Environmental Science. These results align with the findings by Plutzer et al. (2016) and the Penn State University climate change study who reported that a majority of respondents depend on their knowledge from other science disciplines when teaching climate change. This dichotomy of knowledge and experience does not necessarily mean the participants of this research study do not provide adequate climate change experiences for their students. Therefore, it is necessary to unpack further areas of the survey.

Attitudes and Emotions Concerning the Environment

This section of the survey aimed to understand the attitudes and emotions of the survey participants concerning the environment. Participants were asked to consider the following phrase: *Please indicate how strongly you agree/disagree with the following statements*. The associated questions were scaled using a 5-point Likert scale where participants could select their level of agreement to several environmental statements. The level of agreement ranged from strongly agree to strongly disagree with a not applicable choice provided. The data was collected and percentages were calculated for each statement. Table 4.2 is provided to show the data collected.

Table 4.2: Data from the attitudes and emotions concerning the environment survey section

Please indicate how strongly you agree/disagree with the following statements:	SA # (%)	A # (%)	D # (%)	SD # (%)	N/A # (%)
I feel concerned about climate change.	33 (82.5)	7 (17.5)	0	0	0

I feel motivated to do something about climate change.	24 (60.0)	15 (37.5)	1 (2.50)	0	0
I can make a difference with my students by reducing my carbon footprint.	22 (55.0)	15 (37.5)	2 (5.00)	1 (2.50)	0
I can make a difference with my students by teaching about climate change.	31 (77.5)	9 (22.5)	0	0	0
I teach about climate change.	36 (90.0)	4 (10.0)	0	0	0
I cannot reduce my carbon footprint.	0	0	11 (27.5)	26 (65.0)	3 (7.50)
I do not think it is worthwhile to teach about climate change as it will not make any difference.	0	0	4 (10.0)	30 (75.0)	6 (15.0)
Climate change is too difficult for my students to understand.	0	1 (2.50)	3 (7.50)	30 (75.0)	6 (15.0)

Overwhelmingly, the results indicate that participants feel concerned about climate change and are motivated to act regarding climate change. Furthermore, all participants agreed or strongly agreed with the statement that climate change is a part of their curriculum. Both of these findings reinforce the pro-environmental behavior work conducted by Kollmuss and Agyeman (2002) and Howell and Allen (2019) and the Penn State climate study summarized by Plutzer et al. (2016). Kollmuss and Agyeman (2002) described the development of pro-environmental behaviors which stemmed from the

linear progression of environmental knowledge and attitudes. These are reflected in this research data when teachers reported strongly agreeing with reducing carbon footprints (knowledge) and making a difference with their students when teaching climate change (attitude). The participants' positive attitudes are evident when they reported that they disagreed with the statement that it was not worthwhile to teach climate change and when they disagreed with the statement that climate change is too difficult for students to understand. Furthermore, Plutzer et al. (2016) reported that climate change is taught in approximately 75% of public schools and "98% of public high schools teach about recent global warming in at least one class" (p. 11) whereas 100% of teachers either agreed or strongly agreed that climate change is taught in their class. It can be concluded that the AP Environmental Science teachers in this study do in fact include climate change in their curriculum.

Teaching and Curriculum

The next set of survey questions consisted of essential topics involving climate change and whether any of the topics are covered in the participants' AP Environmental Science curriculum. Participants were asked to reflect on the following question: *Are any of these topics covered as part of your curriculum each school year?* A similar 5-point Likert scale was used, however, only three choices were presented: always, sometimes, and never. Table 4.3 is provided to show the data for this section of the survey.

Table 4.3: Percentage of teachers covering essential climate change topics in their curriculum

Question: Are any of these topics covered as part of your curriculum each school year?	Always # (%)	Sometimes # (%)	Never # (%)
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The greenhouse effect	38 (95.0)	2 (5.00)	0
The carbon cycle	40 (100)	0	0
Ocean acidification	38 (95.0)	2 (5.00)	0
Sea level changes	38 (95.0)	2 (5.00)	0
Changes in water quality	38 (95.0)	1 (2.50)	1 (2.50)
Climate change impacts	40 (100)	0	0
Population growth	40 (100)	0	0
Frequency of catastrophic weather events	37 (92.5)	3 (7.50)	

The carbon cycle and population growth are mechanisms of climate change, whereas the greenhouse effect, ocean acidification, sea level changes, water quality and catastrophic weather events are consequences of climate change (Branch, 2019; Plutzer et al., 2016). According to Table 4.3, teachers reported that their curriculum almost always includes these topics. Furthermore, topics that lead to climate change, specifically the carbon cycle and population growth are 100% included in the participants' curriculum where at the same time impacts of climate change are also 100% included. The survey results show that AP Environmental Science teachers who completed this survey are including the essential topics necessary for climate change in their classrooms.

The data reported in Table 4.3 shows similar patterns to the conclusions made in the Penn State climate change survey, yet the frequency was different. In 2016, 66% of teachers reported on the Penn State survey that they covered greenhouse gases in their

curriculum and 63% covered the carbon cycle. In this qualitative research study, 95% of AP Environmental Science teachers always include greenhouse gases while 100% include the carbon cycle. The numbers are dramatically higher in this study when compared to the Penn State climate study.

Teaching about Climate Change

The next section of the survey sought to determine how climate change is being taught in schools. Participants were asked to reflect on the statement: *When I teach about climate change, I emphasize that ...* where several climate change phrases completed the statement. A 5-point Likert scale was utilized for this section and the choices ranged from strongly agree to strongly disagree with a not applicable choice provided as well. The averages were calculated and the percentages displayed in Table 4.4 below.

Table 4.4: Percentages showing degree of agreement of approaches to climate change science

Question: When I teach about climate change, I emphasize that ...	SA # (%)	A # (%)	D # (%)	SD # (%)	N/A # (%)
average global temperatures have risen in the last 150 years.	34 (85.0)	5 (12.5)	1 (2.50)	0	0
natural cycles have produced warming events throughout Earth's history.	27 (67.5)	11 (27.5)	1 (2.50)	1 (2.50)	0
the scientific consensus that recent global warming is caused by human actions.	36 (90.0)	4 (10.0)	0	0	0

many scientists believe that recent increases in temperature are due to natural causes.	6 (15.0)	4 (10.0)	7 (17.5)	19 (47.5)	4 (10.0)
students should come to their own conclusions about the causes of climate change.	11 (27.5)	11 (27.5)	10 (25.5)	6 (15.0)	2 (5.00)

This survey question is where some divergence begins to emerge among participants of this study and the Penn State climate survey. A clear majority of participants indicated either a strong agreement or agreement that average global temperatures have risen in the last 150 years as nations industrialize. Furthermore, 100% of the participants either strongly agree or agree that they emphasize that the scientific community attributes global warming to human actions. These findings are in contrast to Plutzer et al. (2016) and the Penn State climate change data. The Penn state survey found that only 31% of teachers who identified that they teach climate change agree or strongly agree that climate change is caused by human actions. Furthermore, the Penn State survey reported that 30% of participants emphasized a strong agreement that recent global warming is due to natural causes when compared to just 15% of participants in this study. Clearly, APES teachers put a tremendous emphasis on climate change in their classrooms.

The final question in this section of the survey provided the most varying responses in teaching about climate change. When asked whether students should come to their own conclusions about the causes of climate change, 27.5% of participants agreed or strongly agreed while 25.5% disagreed and 15% strongly disagreed. While many of participants agreed with this statement, a significant group of participants disagreed. As

climate change can be a controversial, polarizing topic two different conclusions can be made. Allowing students to come to their own conclusions about climate change can encourage critical thinking and learning steps in their development. As Plutzer et al. (2016) described, exploring controversial topics is empowering and encourages students to think deeper on the topic. Conversely, mixed messages and misconceptions can prevail when climate change is not taught in school (Plutzer et al., 2016).

Motivation to Teach About Climate Change

The fourth section of the survey included questions about the motivation to teach climate change. Participants were asked to consider the following question: *How much are you motivated to teach about climate change by concern about the impacts of climate change on ...* where six potential motivations for action were provided to complete the question. Participants were asked to consider the degree of how often each statement motivates them to teach about climate change. A Likert scale was provided and choices included always, sometimes, and never. The data is provided in Table 4.5 below.

Table 4.5: Percentages showing how often participants are motivated to teach about climate change.

Question: How much are you motivated to teach about climate change by concern about the impacts of climate change on	Always # (%)	Sometimes # (%)	Never # (%)
Future generations	38 (95.0)	2 (5.00)	0
Poorer or vulnerable people	34 (85.0)	5 (12.5)	1 (2.50)
Marginalized people	32 (80.0)	5 (12.5)	2 (5.00)

Family and friends	23 (57.5)	14 (28.0)	2 (5.00)
Impacts on ecosystems	39 (97.5)	1 (2.50)	0
My personal views	23 (57.5)	12 (30.0)	3 (7.50)

This section of the survey was informed by Howell and Allen (2017) and their work on the motivations and formative influences of individuals who act to mitigate climate change. As previously noted in Table 4.2, 100% of the participants in this research study teach about climate change in their AP Environmental Science class. Furthermore, 100% of the participants teach about climate change impacts (See Table 4.3). Therefore, it is concluded that AP Environmental Science teachers in this research study do, in fact, teach students about climate change and its impacts. This section of the survey aimed to determine why.

The data shows in Table 4.5 above that future generations (95%), impacts of ecosystems (97.5%), and poorer or vulnerable people (85.0%) are strong motivators for climate change mitigation. In the study conducted by Howell and Allen (2017), future generations and the poorer/vulnerable people were rated as the highest concerns about climate change impacts with impacts on ecosystems rated as the third motivating factor. The conclusions made by Howell and Allen (2017) that “altruistic concerns about climate change impacts on future generations and poorer/vulnerable people were considered more motivating than other reasons for action” (p. 1) were also shown in this research study. AP Environmental Science teachers who participated in this study also showed a strong connection to altruistic concerns - future generations, vulnerable and marginalized individuals - as motivating factors when teaching climate change.

Social Impacts

The fifth section of the survey asked participants to consider the social aspect of teaching climate change. The prompt for this section was: *When I teach about climate change I ...* where five statements on the social implications of climate change were provided. Participants were asked to determine the level of agreement with each statement using a 5-point Likert scale ranging from strongly agreeing to not applicable. The data is provided in Table 4.6 below.

Table 4.6: Average percentages showing the level of agreement of participants on the social aspects of climate change

Question: When I teach about climate change I ...	SA # (%)	A # (%)	D # (%)	SD # (%)	N/A # (%)
emphasize the social impacts on marginalized people and communities.	24 (60.0)	13 (32.5)	3 (7.50)	0	0
incorporate the effects of climate change on diverse communities.	23 (57.5)	13 (32.5)	3 (7.50)	1 (2.50)	0
incorporate the effects of climate change on developing nations.	28 (70.0)	11 (27.5)	1 (2.50)	0	0
believe climate change affects those who are socioeconomically disadvantaged more than affluent individuals.	27 (67.5)	9 (22.5)	3 (7.50)	0	1 (2.50)
include social justice themes in my curriculum.	26 (65.0)	11 (27.5)	1 (2.50)	1 (2.50)	0

From this section of the survey, the data showed that participants were aware of the importance of social aspects of climate change education. According to the data, the majority of participants either agreed or strongly agreed with all of the statements provided. Previously, the data in Tables 4.3 and 4.4 showed that AP Environmental Science teachers include essential climate change topics in their curriculum. These topics are in alignment with the suggestions by the scientific community (Branch, 2019; Plutzer et al., 2016). However, McKeown and Hopkins (2010) as well as Hines, Hungerford, and Tomera (1987) indicated that knowledge and awareness do not bring systemic change. Rather, components of climate change education should include critical thinking skills, political awareness, social justice, and behavioral change (Howell & Allen, 2017; McKeown & Hopkins, 2010; Pellow, 2018). Each of the statements shown in Table 4.6 include topics of social and environmental justice. Emphasizing the climate change impacts on marginalized people, diverse communities, developing nations, and the socioeconomically disadvantaged are all components of the environmental justice movement (see Appendix B) and the UN Sustainable Development Goals (2020). The survey data showed that AP Environmental Science teachers do incorporate social justice themes in their classrooms, and the interview portion of this study will attempt to understand how this is done.

Personal Values

The final section of the survey required participants to reflect on their personal values when teaching APES. Seven values were presented for the following question: *How important are the following values as a guiding principle in your life as a teacher?* A Likert scale was used and participants were asked to determine the level of importance

ranging from extremely important (EI), important (I), and unimportant (U) with a not applicable choice provided as well. The data is provided in Table 4.7 below.

Table 4.7: Average percentages showing the level of importance of several values guiding teaching practices

Question: How important are the following values as a guiding principle in your life as a teacher?	EI # (%)	I # (%)	U # (%)	NA # (%)
Equality	30 (75.0)	9 (22.5)	1 (2.50)	0
Respecting the Earth	33 (82.5)	6 (15.0)	1 (2.50)	0
Unity with nature	20 (50.0)	16 (40.0)	3 (7.50)	1 (2.50)
Wealth	1 (2.50)	8 (20.0)	30 (75.0)	1 (2.50)
Authority	1 (2.50)	14 (35.0)	24 (60.0)	1 (2.50)
Social justice	29 (72.5)	9 (22.5)	2 (5.00)	0
Protecting the environment	33 (82.5)	7 (17.5)	0	0

Informed by Howell and Allen (2017), the values were carefully selected and categorized in to three distinct themes: biospheric values (respecting the Earth, protecting the environment, and unity with nature), altruistic values (social justice and equality), and egoistic values (wealth and authority). As described in Chapter Two, the biospheric themes have been attributed to pro-environmental behaviors (Kollmuss & Agyeman, 2002). However, Howell (2013) and Howell and Allen (2017) noted the importance of altruistic motivation and concerns for future actions to mitigate climate change.

According to Table 4.7, 82.5% of the participants rated the biospheric values of

protecting the environment and respecting the Earth as extremely important, whereas the altruistic values averaged slightly lower as participants chose equality (70%) and social justice (72.5%) as extremely important values guiding their teaching. However, when combining the extremely important and important categories together, there is a clear indication that participants rated the biospheric and altruistic values equally important as values that guide their teaching principles. For example, 97.5% and 95% of participants rated equality and social justice as important or extremely important, respectively. Furthermore, 100%, 97.5% and 92.5% of participants rated protecting the environment, respecting the Earth, and unity with nature as important or extremely important values, respectively. In other words, these survey results show that the study participants placed biospheric and altruistic values as equally important when guiding their environmental science teaching principles. Lastly, the study participants did place altruistic and biospheric values ahead of egoistic values.

Summary of Survey Results

Chapter Four has thus far presented the survey results of this qualitative, phenomenological study. The survey was designed to determine if AP Environmental Science teachers integrate social justice themes in their classrooms. Secondly, the survey was designed to determine at what level climate change is being taught in AP environmental science classrooms. The results were displayed in tables to guide the reader through the data and to illustrate the espoused theory grounded by the researcher. Below is an abbreviated summary of the survey findings:

1. AP Environmental Science teachers do teach climate change.

2. The essential topics of climate change are included in AP Environmental Science curriculum and are subsequently taught in AP Environmental Science classrooms.
3. Social justice values are considered important concerns and are included in AP environmental science curriculum.

The ease of an online survey tool allowed for a broad reach of participants (Fink, 2017). The survey confirmed that AP Environmental Science teachers do integrate social justice themes in their classrooms and essential topics are covered in the curriculum. The survey began to address the primary and secondary questions of this study but was not a panacea to either. Rather, the interviews were necessary to fully answer each question: *How do environmental science educators integrate social justice themes in their classrooms? Secondly, how has environmental education evolved to incorporate climate change education?* The survey confirmed that teachers do in fact include social justice themes in their classrooms. Furthermore, the survey confirmed that environmental education includes essential topics and knowledge to address the science behind climate change. The proceeding section will describe the results from the interviews and show how memo writing was used to ground the theory learned to answer the research questions fully.

Reporting of the Interview Results

Introduction

Eight interviews were conducted beginning on January 24 and concluding on January 28, 2021. All 14 participants who provided contact information at the conclusion of the survey were contacted and eight responded with continual interest to participate in an interview. The interview questions were informed by the survey and conducted via

Zoom. Participants were emailed the interview questions (Appendix C) and consent form (Appendix D) before the interview took place. Each semi-structured interview was recorded, transcribed, and then subsequently coded as suggested by Maxwell (2013). Through memo writing (Charmaz, 2006; Saldaña, 2013), categories emerged and were used to ground the theory to answer the two research questions.

Upon completion of the interview, the following theories emerged: the importance of case studies, providing local examples, the importance of college training programs, and using current events to promote environmental literacy. These theories will be addressed entirely at the end of the chapter. Chapter Four concludes with a thorough summary addressing the research questions before a preview of Chapter Five.

Interview Demographics

All interviews were recorded through Zoom and transcribed verbatim. Each interview began with an icebreaker question: *How has your year been thus far during COVID?* Icebreaker questions are meant to build a trusting relationship between researcher and participant in order to encourage a meaningful conversation (Brinkmann & Kvale, 2015). The icebreaker question also allowed the researcher to determine if the interview was recording properly. After the icebreaker question, participant demographics were collected and reported in Table 4.8 below including the type of current school, total number of years teaching, and total number of years teaching APES. Unintentionally, but important to note, all participants identified as female. In order to protect anonymity, participants were numbered chronologically as participant #1, #2, etc. Among the interview participants, Table 4.8 shows the average number of years teaching is 8.6 years, and the average number of years teaching APES is 4.3 years.

Table 4.8 Interview participant demographics showing type of school, years teaching, and years teaching AP Environmental Science.

	Type of School	Total Years Teaching	Years Teaching AP Environmental Science
Participant # 1	Private	5	3
Participant # 2	Public	10	3
Participant # 3	Public Charter	1	1
Participant # 4	Public	11	6
Participant # 5	Public	15	7
Participant # 6	Public	2	2
Participant # 7	Private	18	6
Participant # 8	Public	7	7

When completing the memo writing portion of coding the interview transcripts, it became clear that the results from the interviews needed to be reported as narratives. I found myself captivated by each participants' journey. I enjoyed listening to their childhood and college experiences and how these formed their own ecological identities. I found their moments of social justice development and implementation fascinating. Therefore, I found it prudent and most helpful to share each of their experiences individually, instead of collectively. Each interview, therefore, will be reported as a summary of the conversation, capturing the lived experiences and knowledge of each participant. Theory will then be grounded and shared. Stories are a central component of social justice and a significant topic throughout my doctoral studies. While this phenomenological study is not grounded in ethnography, sharing each participant's journey to environmental education, significant life experiences, concerns about the

environment, and inclusion of social justice themes will guide the reading through the grounded theory learned. Following each story, I will share my personal reflection on the conversation and the emerging theories as they become clearer. The espoused theories that emerged will be included in my reflections and used to answer the primary and secondary research questions at the end of this chapter.

Interview with Participant #1

Her journey to environmental education. Participant #1 is currently in her fifth year of teaching, three of those in AP Environmental Science. At the beginning of her college coursework, she intended to major in English and humanities. However, she was introduced to environmental science during an elective course her freshman year and was forever hooked. Specifically, she said, “The environmental science class just, like, opened my mind to a whole new world.” She quickly changed her majors to environmental science and Spanish.

Significant life experiences. She also spoke fondly of significant life experiences that fostered her strong affinity for the environments. She said, “I’ve always loved hiking and have grown up doing a lot of big outdoor things, so it's always kind of been in my personality. I just didn’t think about pursuing environmental science until my first year of college.” Furthermore, she has fond memories of spending time outdoors with her father and traveling to national parks, traveling abroad, and visiting the Amazon Rainforest. Her trips to both South America and rural India, where she witnessed poverty directly, were transformational moments for Participant #1 and have shaped the environmental and social justice frame of reference that she brings to her classroom. During these travels, Participant #1 began writing, and she used journaling as a way to capture her

understanding of privilege and positionality. She stated, “Now that I think about it, that dichotomy of class and seeing such extreme poverty like nothing I’ve ever seen before in my life ... it totally, totally changes your frame of reference because of my upbringing, you know, White middle class.” She credits these experiences as influencing her lessons in her classroom.

Concerns about the environment. Participant #1 wants her students to have a foundational understanding of the science behind climate change. She described how she includes common topics like population growth, biodiversity loss, plastic use, and detrimental human behaviors that influence climate change. She often tells her students, “The earth is on fire and it’s our fault.” Most of the discussion about major concerns centered on actions by large corporations to meet global demands for products. She emphasized the interconnectedness of life and how increases in population and globalization lead to an increase in industry resulting in environmental health costs. Therefore, her strategy is to make climate change a priority throughout all of the units during the school year. To do so, each unit comes with a reflection component. For example, she encourages her students to agree or disagree often. This is done through writing and classroom discussion. She also incorporates climate change education during the geology unit and biogeochemical cycles. She is mindful to integrate climate change throughout the year, but this was not explicit at the beginning of her APES teaching career. She recalled doing an agree/disagree activity with daily plastic water bottle use and how all of her students agreed that daily plastic water bottle use was an acceptable practice. At that moment, she knew climate change, human behaviors, and human activities needed to be incorporated throughout all of her classes.

Social justice in her classroom. Participate #1 described biodiversity, energy, pollution, and population trends as being favorite topics in her APES classroom. These are common AP Environmental Science topics and are included by the College Board. However, Participant #1 links these common topics to social justice themes through the use of case studies. She spoke fondly of case studies on biodiversity, the heat island effect, and food deserts. Through current events and case studies, she introduces her local community as well. Her local case studies focus on environmental impacts on minorities as she recalled a few activities, “I do case studies on urban heat islands, and we look at how black and brown communities are disproportionately affected. Furthermore, we do case studies on food deserts, where I have them [her students] map their neighborhood and all of the different grocery stores. I mean, to see how much further people have to walk to get to a grocery store is more about why this really matters and less about the science.”

To her, inclusion of women’s rights around the world is the most significant component of her social justice curriculum. One particular part of her population unit is to have her students read and discuss the importance of women’s education around the globe. She notes, “One reading we do is an article on global population growth and the connection between women and sending them to school and, you know, how the fertility rates plummet.” She noted her initial hesitation around sharing this idea, especially with the boys in her room. However, she was “blown away by how articulate and how compassionate and empathetic they were towards this topic.” She credits this as a catalyst for continuing the social justice and equal rights conversations in her APES classroom.

Researcher's Reflection. I was immediately impressed by this participant's energy and enthusiasm for environmental education. It was clear to me that she has a strong foundation of the APES curriculum and employs social justice topics in her classroom. Her childhood was steeped in outdoor experiences, and her travels abroad have helped her realize her positionality and the effects of extreme poverty. She includes meaningful opportunities for her students to reflect on environmental justice themes such as food deserts, air pollution, and women's rights to education. "The world is on fire and it's our fault" leaves a lasting impression on her students.

Interview with Participant #2

Her journey to environmental education. Similar to Participant #1, Participant #2 began her environmental education journey in college. She has been teaching for a total of 10 years, three of those in an APES classroom. Her first environmental science course in college really opened up [her] eyes to a whole new world." She has a strong background in geology and Earth's processes, both topics she brings to her APES classroom. She credits her time working in the geology department for fostering her strong appreciation for and fascination with the scientific community. This is why she strongly believes her students need to understand the science behind climate change in order to make informed decisions.

Significant life experiences. Participant #2 described common biospheric experiences involving nature - playing in the woods, collecting flowers, and traveling to national parks. She also credits her work as a geology major for inspiring her to teach APES. She stated, "Teaching Earth science over the years wasn't really related to current events and was very much like a classic geology class, you know, the formation of rocks

and minerals. And, then I discovered environmental science and all the social impacts and how you can apply [them] to your daily life.” Her strong science background gave her the knowledge that she needed to understand scientific processes. She jumped at the opportunity to teach AP Environmental Science so she could combine her love of scientific processes and how humans influence these processes.

Concerns about the environment. Participant #2 enjoys teaching the population unit and celebrating the cultures of other people best. She stated, “Putting yourself in other people’s shoes - seeing, you know, whether they’ve got it better or worse. Everyone brings such beautiful culture and is not afraid to speak it.” Here, she was discussing the diversity she has in her own classroom and the gifts that her students bring to the discussions. Sustainability is another concern she has about the environment, and she stresses how all of her students can do their part to make more sustainable choices even though it can feel so overwhelming at times.

Social justice in her classroom. Participant #2 has a strong scientific background and a strong understanding of social justice activism. She spoke often of using case studies, current events, and developing the scientific literacy of her students. Being able to read and understand articles about superfunds or brownfields, for example, positions her students to be able to reflect on how these sites disproportionately affect communities of color. She is continually using case studies from her local community, so her students have a stronger appreciation for what is happening in their own neighborhoods. She uses case studies on gentrification, economic disparities between developing and developed nations, as well as land pollution and plastic use. Most important, though, she stresses to her students how they have an individual choice and responsibility to behave more

sustainably. She said, “Sustainability is something that I feel strongly about. I feel so strongly that everyone can do their part. You can recycle even if you feel that a lot of APES issues seem so overwhelming at the moment. You can recycle and do your part for the environment.”

Researcher’s reflection. It is clear to me that Participant #1 has a strong foundation in the sciences. She brings a wealth of knowledge on geological processes and passes this on to her students while incorporating human impacts on these processes. She challenges her students through case studies, local, and current events, and she encourages her students to think and behave like scientists. She understands the importance of scientific literacy. Her ultimate goal is to have her students become better people in society, regardless of their homework assignments or AP scores. Becoming a better person is top priority and can be accomplished through individual choices - recycling, reducing footprints, reading food labels, or through purposeful volunteer work. She tells her students that they can make a difference.

Interview with Participant #3

Her journey to environmental education. Participant #3 is a first-year teacher currently teaching several additional disciplines besides APES. She is the eighth-grade science teacher, the tenth-grade biology teacher, and the 11th grade environmental science teacher. Her day is highly structured, but she enjoys the pace and the opportunity to vertically align her curriculum and integrate climate change throughout. Her undergraduate work is in biology, and teaching was not part of her planned path. As a young child, Participant #3 gravitated to the outdoors and took these interests to college. She stated, “I grew up, you know, my family are huge sportsmen, hunting, fishing. And

though I never particularly liked to partake in like the actual taking of the animals. I like to be outside and thought that college was pretty rad that, you know, people go to school to study this and learn how the environment works.” Her college coursework introduced her to environmental studies. During summers, Participant #3 worked several outdoor oriented service and teaching jobs. She conducted wildlife research during college and worked at a zoo focused on teen programming and education. She also enjoyed teaching kids at several summer camps. These experiences encouraged her to complete her teaching degree.

Significant life experiences. Several times throughout the interview, Participant #3 spoke of her rural upbringing. Her childhood home was surrounded by wilderness, trees to climb, and lakes to swim. She spoke excitedly about the outdoor spaces she had to run around in and enjoy by her family’s cabin. She has childhood memories of herons, loons, and other wildlife watching and knew every hiking and four-wheeler trail in the woods adjacent to her cabin. She referred to these experiences as a privilege. When asked about her biospheric development she pensively stated, “You know, the fact that I was just constantly exposed to the outdoors for my whole childhood and all of the wildlife present. Like, we knew the loon family lived there every year and we looked forward to seeing it. I never realized my childhood outdoors was a privilege to have.”

Concerns about the environment. Participant #3’s childhood experiences and studies in college have framed her concerns for the environment. Regardless of her burgeoning teaching career, Participant #3 understands that the impacts of climate change do not affect everyone equally. She spoke of environmental concerns that align with other interviewees - air and water pollution, coastal degradation, loss of biodiversity,

sustainable agriculture and food insecurities. Participant #3 also spoke of utilizing Aldo Leopold's *A Sand County Almanac* in her class. In his conservationist approach, Leopold (1949) compared the profound interconnectedness of all things in an ecosystem to thinking like a mountain. Participant #3 realizes that climate change makes this much more profound when she stated about Leopold's thoughts, "But the idea, you know, being able to understand the interconnectedness of everything and having that great skill is important in APES. It seems like almost every single concept in APES, always, when you're thinking like a mountain and you're thinking about all the different interconnected parts, it always comes back to climate change, right. And my students know and appreciate this. It's always there."

Social justice in her classroom. Participant #3 has a strong grasp on social justice inclusion in her AP Environmental Science classroom. She brings in case studies and local, current events to reinforce the environmental science topics she includes in her curriculum. She keeps her examples local for her students to appreciate and understand. Food deserts and access to nutritious, healthy foods is a case study she highly enjoyed using this school year. She incorporated research done on the area by the local university and even took a walk with her students after examining local geography maps. She incorporates environmental justice topics in these case studies and how processed foods leads to long term health effects. Furthermore, she includes the local paper mill in her classroom as an example of environmental injustices. She stated, "Driving down the highway, you can see the papermill and other factories. These are right around a bunch of little houses and the people who live in that neighborhood are predominately very, very low income. So, it's visible, you know. The people that live more comfortably live out in

the lakeside neighborhood but not there. It's very, very visible, you can totally see it."

She utilizes a very similar case study of a power plant located in a predominantly minority community in a major city of her state. She connects the air quality surrounding the power plant to health concerns. This is a major initiative of the environmental justice movement.

Researcher's reflection. I was impressed by both her vast knowledge of current events and the environmental justice initiatives in her local community and beyond. Towards the end of the interview, I understood better how impactful the Black Lives Matter movement was for her. Although she did not attend any gatherings, she met people who had and took the time to understand their experiences and stories. One experience that made explicit the environmental justice movement to her was a story she shared from Minneapolis, Minnesota involving the Rondo neighborhood. Participant #3 admitted that she grew up in a predominantly White, middle-class family. In college, she met a friend who attended the Interstate 94 freeway shutdown protest, and this friend was one of her first Black friends. She recalled, "I remember speaking with my friend about the interstate protest. And, I was like, what's the Rondo neighborhood? So, then I looked a little bit into that and learned that all these White people are moving around the cities and moving to the suburbs. They need to take I-94 back to work in the cities. Well, the interstate cut right through the Rondo neighborhood and destroyed this area that was written in Black culture." This was the first time she heard of environmental justice and this helped to frame her journey and social justice inclusion in her classroom. This example allowed her to finally give a name to the ideas and emotions she was struggling with during college. That is why her greatest wishes for her students are to think critically

about local events, to question what they see, and to remember that environmental injustices are everywhere.

Interview with Participant #4

Her journey to environmental education. Participant #4 is currently in her 11th year of teaching with six years of experience teaching APES. Throughout her career, she has also taught on-level environmental science and biology. Similar to the previous participants, Participant #4 became interested in environmental science and education during her college years. She worked on an air quality research project with minority local middle and high school students for an environmental science elective in college. She described how these students were predominately Black and lived near subway lines in a large city in California. They walked around this neighborhood collecting air samples and measured the particulate matter content and compared it to suburban neighborhoods away from the subway lines. This was her first experience with environmental injustices and how Black and Brown neighborhoods tend to be more polluted. This was such a transformational experience that she decided to switch majors. She stated, “The environmental injustices were really present in that experience. I was actually a business major at that time, and this was the reason why I switched to biology because I knew I wanted to teach science and I wanted my science classrooms to be centered around environmental injustices.” Clearly, her undergraduate experiences have informed her career choices and classroom curriculum.

Significant life experiences. Participant #4 was open about the financial struggles her family faced growing up. However, she did have the opportunity to attend a rather affluent public school and noted that she did not face many of the injustices that

she teaches about today. She recalled, “I was really lucky to attend a public education system in a very affluent neighborhood. And so, because of that I never really felt like there was an injustice that I personally experienced. But my time in college when I started working with communities that have been historically oppressed and don’t see opportunities that I did in terms of education gaps, food resource gaps, and healthcare gaps, that’s when I learned that this [environmental injustice] is such an issue. This is the reason why I went into environmental education, as kids need to know that EJ exists in order to be able to advocate for themselves and for their communities.” She wants her students to feel empowered to create change.

Concerns about the environment. Participant #4, as evident by her undergraduate experiences, was not drawn to environmental education based on her concerns for climate change. Rather, she was drawn to the field for her concerns about environmental justice. She was candid that she struggles to teach climate change as it often makes her students feel powerless. She described several topics that align with the College Board curriculum - increases in surface temperatures, food insecurities and deserts, coastal degradation, extreme weather, and air pollution. Her largest concern is spreading despair. She wants to provide her students with optimism and the idea that small individual choices and changes are meaningful, sustainable, and capable of reducing climate change impacts on marginalized communities.

Social justice in her classroom. Participant #4 has a strong sense of environmental justice and brings a depth of experience to her classroom. First, she enjoys taking her students on field trips. She took her students to inner-city neighborhoods to experience food deserts and the undernutrition that results firsthand. During the land

pollution unit, she took her students to a landfill to talk about hazardous waste and discussed the proximity of minority dense neighborhoods to superfund and brownfield sites. These hands-on experiences are vital in the environmental justice movement.

Researcher's reflection. It was clear to me, almost immediately, that her biggest priority in her APES classroom is to empower her students to advocate for themselves and for their communities. She has a very strong grasp of environmental justice and knows its exact genesis. Her undergraduate work was grounded in case studies and she continues that work today by having her students examine local case studies on air quality, pollution, and access to nutritious food. She also indicated that she has similar conversations in her regular biology classes, planting the seed for her future APES students. She spoke clearly about how she went into teaching to provide accurate scientific information through a social justice lens. Furthermore, she stresses science literacy. She hopes her students think and question like scientists and become activists for their own communities. Lastly, her course is designed so her students have the experiences and chances to become scientifically literate to address environmental injustices they, or others, experience.

Interview with Participant #5

Her journey to environmental education. Participant #5 has been teaching for 15 years with seven of them specifically in APES. She has taught biology, science research methods, and technology courses in the past. From a young age, she knew she wanted to do something with outdoor education. She credits her mother with instilling a sense of connection to the outdoors. She has fond memories of the forest adjacent to her

house growing up. Her mother would pull her from school to go on nature hikes, to zoos, or to museums. Her family made the outdoors a priority during her childhood.

Significant life experiences. Participant #5 recalled a story from her childhood involving Styrofoam containers and the grassroot efforts to eliminate it and switch to paper containers. She stated, “This was a campaign at a local McDonald’s to get rid of Styrofoam and switch to paper containers and things that were biodegradable. This was something where I understood people can be involved in changing policy and changing the action of large corporations to do things in a way that’s more sustainable.” Because of this experience, she gravitates towards including water and land pollution, food deserts, and sustainability in her APES curriculum.

Concerns about the environment. Along with concentrating on the environmental impacts of large corporations, she impresses on her students the detrimental effects humans have on biogeochemical cycles. She is mindful to show where humans influence the carbon cycle, for example, and then has her students reflect on their own practices. This is how she incorporates climate change throughout the year by examining the human impacts on different processes.

Social justice in her classroom. Participant #5 described how the air and water quality units of her course include moments of social justice inclusion. She includes case studies on nutrition and the equitable access to healthy food within her school communities and the neighborhoods of her students. Throughout the interview, she spoke of community and the altruistic nature of helping others in need. She stated that community has “always been something that’s important in my family. And so, I feel like, for me, the environmental component is just an extension of that. If it is important to

support and help all people, it's important to make sure that all people have access to healthy food. It's important to make sure they all have access to clean water. And I think that kind of ties it all together." Furthermore, Participant #5 spoke of environmental knowledge as a means for self-advocacy and the advocacy of others. She wants her students to have the content background to be informed participants in their community and to be advocates for the decisions that they think will best support the people in their community to live in a healthy and safe place.

Researcher's reflection. Participant #5 has a strong sense of environmental justice, and her affinity to it stems from the strong community that she grew up in. Her parents were part of a union. She had strong neighbors and went to a strong, supportive school. To her, community comes together and recognizes that you are part of a community and when there are inequities, they are addressed. I was immediately drawn to her confidence and experience. She has a strong sense of social justice, and the environment is an extension of those feelings. Having access to healthy food, clean air, and clean water is important, and through case study and local current events, she makes the interconnectedness of all living things explicit. Our conversation was not driven by climate change. Rather, we discussed sustainability and making the content accessible to all students. One particular thing to note, Participant #5 was the only teacher interviewed who spoke directly to AP teacher training and suggested that new AP teachers be trained in urban education to understand the dynamics of students who may be from underrepresented populations. A self-proclaimed, bleeding-heart liberal, Participant #5 demonstrates a strong affinity with environmental justice.

Interview with Participant #6

Her journey to environmental education. Participant #6 is a second year APES and biology teacher. As the new biology teacher hire, she had very little experience in environmental science education until she began teaching it two years ago. She credits the collaboration within the AP Environmental Science Facebook group for inspiration and guidance and now absolutely loves the course and is continually looking for ways to incorporate more climate change moments in her curriculum.

Significant life experiences. Participant #6 was open and honest about her struggles in school growing up. She did not speak of time outdoors or biospheric appreciations that other interviewees discussed. Rather, she was bullied in school and now focuses her energy and fights for justice for those who are marginalized. She is an ally for the LGBTQ community and actively advocates for equal rights for all people.

Concerns about the environment. Although her curriculum is in the fledgling phase, Participant #6 already demonstrates proficiency in important environmental topics. She incorporates case studies in environmental toxicity, especially lead and mercury contamination at landfill and mining sites. She encourages her students to shop local and to grow their own food. Specifically, she helps manage the community garden at her school. Her student body is predominantly Black, and she encourages them to learn about growing their own food and learning where their food comes from to reclaim some of the negative connotations of farming for African Americans.

Social justice in her classroom. Not only is Participant #6 an ally for the LGBTQ community, she also champions women's rights. She connects women's rights to agriculture. She said, "Empowering women is one of the most important things to

bring forth systemic change in agriculture and population growth. In some developing countries, women don't have rights to land, don't have rights to get loans for machinery, but they're the best at agriculture and have traditionally been the ones that have been doing it. So, we get really into it when we're talking about empowering women.”

Researcher's reflection. Participant #6 spoke often of sustainability topics that are linked to environmental justice. It is clear to me that she provides moments for her students to discuss issues like food insecurities, women's rights, and access to clean air and water. This was the first interview where the participant did not identify any strong affinity towards the environment based on any significant life experiences or growing up outdoors and playing in the woods. Rather, she took her own experiences of feeling marginalized and turned that into action for her students. This was all unplanned, as she became an environment science teacher based on the needs of her school. Even though she has spent little time planning for or including climate change topics, she already has a strong foundation for environmental justice that will continue to grow as she gains more experience.

Interview with Participant #7

Her journey to environmental education. Participant #7 is a master teacher with 18 years experience. She has taught a variety of science disciplines throughout her career. She has experience in Earth science, biology, geology, oceanography, chemistry, and APES. She has taught APES for a total of six years. She did admit that she did not have much experience with environmental science until she began teaching it. She stated, “I went in not having any experience teaching ES and so once I got thrust into it, though, it took me for a ride and really captivated me and now it's my favorite class to teach.” She

is currently at a project-based, college preparatory school which aligns itself with the discussion and reflective nature of AP Environmental Science serving mostly affluent students from upper-middle class families. She uses this to her advantage to teach climate change. She stated, “We don’t see a lot of direct impacts of climate change where we are, except for the occasional drought. And so, it’s so removed from the kids’ reality that I have to kind of backdoor their climate change education and really approach it from a research standpoint and give them a problem to solve. Then, all of a sudden, they’re like ‘oh my God, climate change is a really big problem.’ But, if I had told them that climate change is a really big problem, they wouldn’t care.” Her students construct their own knowledge and conclusions on climate change.

Significant life experiences. As a child growing up, Participant #7 spent a great deal of time outdoors. She took every single high school science course she could and knew she wanted to teach science for a long time. She credits her college coursework as giving her research experience. She has also traveled extensively around the United States and abroad during her college years which instilled a passion to stand up for social justice rights. She has marched at the Capital for a fair minimum wage, she has volunteered for initiatives handing out pamphlets, and written letters to senators. She has been involved in the Jesuit Volunteer Corps and worked at a homeless shelter for kids in a large inner city. She stated, “And so, seeing the inner-city injustices coupled with the work that I had been doing with social justice in college stayed with me. Just a couple of years later I was teaching environmental science and was introduced to this whole idea of environmental justice and so then that kind of just merged the two for me.” Her experiences in college and beyond have influenced her social justice concerns.

Concerns about the environment. Participant #7 discussed how she shares her concerns with her students through the project-based learning methodology. Without a doubt, her biggest concern is climate change, and this is what she focuses on throughout the year. She stated, “They discover the big problems of climate change on their own and to me that authentic kind of learning makes it more real to them, as opposed to just something to learn and memorize to get a good grade.” She also conducts projects on poverty, energy, biodiversity, and food deserts.

Social justice in her classroom. Participant #7 ends each year with a culminating project titled “is climate change a social justice issue?” Her students need to answer this question based on their own research, reflection, and presentation preparation. Her ultimate goal is to have her students construct their knowledge that climate change is a social justice issue. Ultimately, students are building up to this point by completing projects throughout the school year. She encourages her students to find local examples and case studies and to look at the data. Her projects include work on poverty, income inequality, and women’s rights. Participant #7, through her childhood and college experiences, constructed her own social justice knowledge, and she stresses the same for her students.

Researcher’s reflection. I was impressed with her class organization and efforts to have her students construct their own knowledge. She has three units throughout the year, peppered with project-based learning: How does the Earth work? What does it mean to be human? How do humans and the Earth interact? From my perspective, her project-based learning model has allowed her to connect several different topics at once to climate change. She stated, “I think this: racial justice, diversity, equity, inclusion you

can't have it, you know, social justice, you can't have environmental justice if you don't have racial justice. It all comes back to inequalities in society and how it's the communities of color and the communities that are poor and the communities that are disadvantaged, whatever country you happen to be in. Those are the first ones that feel the effects of climate change, the first ones that feel the effects of resource depletion and different issues." This is an extremely powerful quote from a teacher who is working directly with her students to realize this. She wants her students to appreciate the Earth and the gifts that it gives us. But, most importantly, she wants her students to see how life is interconnected. She finished the interview with the following statement, "And, humans are a part of that interconnectedness, not separate from it. But really, humans are part of Earth's ecosystems and that we can be an important species within the ecosystem or we can be that invasive species within the ecosystem." This was a powerful interview with a dedicated and talented teacher.

Interview with Participant #8

Her journey to environmental education. The final interview of this phenomenological qualitative study was with a public school teacher who has been teaching for seven years. She has taught APES and a writing seminar her entire teaching career. She grew up in a rural part of the country and has fond memories of spending the entire day outdoors. From a young age, she wanted to be a scientist and had environmental heroes like Al Gore. Initially, she wanted to be an environmental lawyer and work for the Environmental Protection Agency. Although she did not go to law school, it did take her eight years before she went back to school to become a teacher.

Significant life experiences. Participant #8 comes from a coal-mining family. She has vivid memories of watching her grandfather and uncles return home after spending 12 hours in the local mines. She would watch them remove their dirty overalls and wash off their equipment at the outdoor water spigot. She shared a story of her grandfather bringing home what would become a family heirloom. Her grandfather brought home a large lump of coal that has stayed with the family ever since. This coal personified the hard work her grandfather endured to provide economic stability for her family as she knew they could sell that coal for money if needed. It turned out to be her symbol of economic success, while at the same time, an environmental degradation tool. She remembers as a child wondering why he needed to have a job that made him cough up so much black dust. Her hometown was also poverty stricken. She saw first-hand the income inequalities that existed and connected that to how hard her family worked in the mines while large corporations continued to make huge profits. She stated, “No one is taking ownership of the destruction of our planet. I am angry, but in a good way.” These experiences have become an important part of her identity.

Concerns about the environment. From the onset of the interview, Participant #8 blamed capitalism and the inequality of resource use for climate change and global pollution. Climate change is part of every single topic and unit she completes with her students. She mentioned several common topics like pollution, food security, land use, and farming practices. However, she kept gravitating back towards capitalism and holding those accountable for the environmental issues when she cautioned, “We have to hold those big corporations who are responsible for most of our climate change. So really, when I talk about climate change, I teach the science of it. I also tell them the

Earth will be fine without us, the Earth will fix itself without us. We're not worried about saving the planet, we're worried about saving our hearts. And to do that, we have to hold those people accountable." Without a doubt, climate change is her largest environmental concern.

Social justice in her classroom. Participant #8 has a strong background and personal interest in social and environmental justice. Her theme for this school year is environmental justice is racial justice. She does this through case studies from local indigenous people and the inequalities they face. She spoke of current case studies like recent wildfires in Australia and California. Throughout this work, she consistently brings it back to social justice. She has her students reflect on and discuss questions like why is this happening? What and who caused it? How are different people affected by it? She also advocates for environmental science jobs to encourage her students to get involved. She tells them they can be environmental writers, lawyers, or governmental officials. She stated, "By the time they leave me, they always say environmental science is everywhere and you can't fix something from inside a broken system. If they learn nothing else, they know that." She is cultivating the next generation of activists to address the broken system she described.

Researcher's reflection. Participant #8 has a strong grasp of the economic, social, and environmental issues plaguing sustainability. She is knowledgeable, dedicated, and inspiring. She is comfortable sharing her personal stories and experiences with her students to make the material more meaningful and relevant to them. I can see the passion and emotions that she brings to the classroom. When telling me about her population unit, she said, "And when we talk about populations and we talk about human

health and we talk about, you know, malnutrition. I'm seeing kids in my classroom breakdown when I show them pictures from around the world. They say those pictures look like their own baby photos. I think a lot of it's just anger that we don't care enough about each other to care about the problems we are creating for the planet." It was at this point that she began to break down. We paused during this portion of the interview. I knew she unequivocally captured what AP Environmental Science teachers are striving for while listening to her speak. She captured the balance between knowledge, passion, awareness, and hopefully optimism. Although climate change is the biggest threat to our planet, she wants her students to know one thing; that they are, "completely and inherently and unequivocally loved" when they leave her classroom.

Addressing the Research Questions

The primary research question for this qualitative research study was: *How do environmental science teachers integrate social justice themes in their classrooms?* The survey confirmed that 93% of the participating AP Environmental Science teachers do, in fact, report the integration of social justice themes in their classrooms. The survey also confirmed that AP Environmental Science teachers do include several common climate change topics in their classrooms. This addresses the secondary question: *How has environmental science education evolved to incorporate climate change education?* The semi-structured interviews were conducted to fully address the research questions. Through memo writing, theories began to emerge from the coded transcripts. It became clear that to fully unpack the theory learned from the interviews, each of the participants needed to have their environmental story told. Through the memo writing and the stories shared, the theories below emerged and were used to address the research questions.

Case Studies

All of the interview participants described their use of case studies. Case studies are commonly used in the AP Environmental Science classroom. In this study, teachers reported the use of case studies to address common climate change impacts like air and water pollution, food insecurities, and how these impacts affect different people. Case studies also typically include data that students can then interpret to make conclusions on their own.

Local Connections

All of the interview participants described the importance of framing global issues and climate change science using examples from their students' own neighborhoods. This local connection gives credence to the power of individual choice to make sustainable choices. The study participants also discussed the valuable tool of field trips to local brownfields, superfunds, and to explicitly observe food deserts. All of the study participants described efforts in their teaching to discuss the inequality of access to healthy, nutritious foods for all individuals in a community. Observing food deserts firsthand is a powerful way to describe the environmental justice movement.

College Experiences

Not surprisingly, several interview participants describe fond memories of their childhood spent playing in the woods. What was surprising was to hear how impactful their college experiences were to their development of social justice concerns. Several participants described moments of activism including the Black Lives Matter movements and other protests as being meaningful experiences during college. Several participants also described doing research in college and collecting real, verifiable data for scientific

research. Furthermore, the participants described their experiences working with kids during college through a variety of levels and activities. Whether through zoo camps, summer camps, or student research, many of the participants began working with kids in an educational setting in college. This goes to show the importance of teacher training programs and the environmental justice movement. This is an opportunity to create more moments of social justice inclusion in undergraduate training programs. While the extent of teacher training is beyond the scope of this study, this is an area that should be further explored.

Environmental Literacy

The final theory grounded from this research study is the importance of environmental literacy. All of the participants hoped their students would develop their own scientific knowledge through reading, writing, and thinking like scientists. Each participant hopes their students think critically about current events, case studies, and other environmental issues preventing sustainability. Current events were discussed over and over again. Based on the interview, the teachers have their students read, reflect, and discuss almost on a daily basis. Current events are also connected to social justice themes. Teachers reported that they can integrate social justice themes through current events by connecting current events to the curriculum. This is a dynamic process and requires planning on the part of the teacher. However, all participants described how the spontaneity of AP Environmental Science is what draws them to it.

Chapter Four Summary

Chapter Four began with a review of the rationale for the methodology used in this qualitative research study. Both an online survey and semi-structured interviews were used to answer the primary and secondary research questions:

How do environmental science teachers integrate social justice themes in their classrooms? They do this through the use of case studies, local experiences, college preparedness programs, and through environmental literacy initiatives. They create opportunities for their students to connect the scientific concepts and social justice through these four areas.

How has environmental education evolved to incorporate climate change education? AP Environmental Science Teachers reported on the survey that they do include common climate change topics recommended by leading science climatologists.

Pro-environmental behavior development through the appreciation of nature continues to be relevant, but environmental education must include the scientific concepts that mitigate climate change. An overwhelming majority of the survey participants reported that they do in fact, teach those topics.

Chapter Five will include a brief review of the literature relating to the theory grounded from the survey and interviews to address the research questions. Following this, the study implications and limitations will be discussed followed by brief recommendations for further research. This dissertation will conclude with plans for using the results before a final thought is provided.

CHAPTER FIVE

Conclusion

Continents are on fire, glaciers are melting, coral reefs are dying, fish are disappearing from our oceans. The list goes on and on. But we know what to do about it
- David Attenborough

Overview of the Chapter

Chapter Five is the concluding chapter of this dissertation and will summarize the findings of this phenomenological study with the following primary and secondary questions: *How do environmental science educators integrate social justice themes in their classrooms. Secondly, how has environmental education evolved to incorporate climate change education?* The chapter will begin with a concise review of how the literature is connected to my study's findings and the emerged theories. Furthermore, I will discuss the implications of this study and recommendations to the environmental education field before sharing my plans for communicating the results. Finally, I will offer a final reflection on the dissertation process and my research study.

Introduction

Both an online survey and qualitative, semi-structured interviews were the research tools used for this study. Upon completion of both, emerging theories to address the research questions became more evident after completing the memo writing procedures. The survey confirmed that my participants do in fact address climate change and integrate social justice in their classrooms, so the interviews were designed to learn how social justice integration takes place. Through memo writing (Maxwell, 2013), categories and theories emerged from the interview transcripts and were presented in Chapter Four. Soon after I began the coding process, I realized that my interview

questions were framed to understand the lived experiences of my participants, not necessarily their methodological approach to social justice. While substantial knowledge was gained, I found myself intrigued by their environmental philosophy development and journey. Therefore, the results were shared as ecological narratives with my subsequent reflections.

Review of the Survey

The survey results confirm that my participants do in fact teach common climate change topics and incorporate social justice themes in their classrooms. Data Table 4.2 shows strong concern about climate change, motivation to do something about climate change, and confirmation that climate change is taught by my survey participants. Furthermore, the data in Table 4.3 overwhelmingly indicates that survey participants teach common climate change topics such as the carbon cycle, air and water quality, global impacts, and population growth. Lastly, the survey results on Table 4.5 confirm that participants are highly motivated to teach climate change based on social justice ideals such as marginalized people, the poor or vulnerable, and future generations. What is important to note, however, is some individuals reported that they do not emphasize the social impacts of marginalized communities or the negative effects of climate change on diverse communities even though the majority of participants confirmed that they do include social justice themes. Some individuals may not know what social justice looks like in their classrooms. Nevertheless, the survey results strongly indicate that social justice themes are integrated in curriculum and climate change is taught among the survey participants.

Review of the Interviews

The survey helped to inform the semi-structured interviews. Memo writing (Maxwell, 2013) and grounded theory (Hatch, 2013) were the primary methods used to qualify the theories that emerged from the eight interviews presented in narrative form. Each participant was an Advanced Placement Environmental Science teacher who also taught other disciplines. Most participants discussed how environmental science was added to their teaching load after the hiring process and how APES quickly became their favorite discipline to teach. It was also notable that teachers were incorporating their own vertical alignment of the curriculum. For example, several participants who also teach biology noted how climate change, food deserts, and air quality are now topics that they bring into their biology curriculum. They use moments like these to build interest for their APES class for future students. From the interviews, several theories emerged that were used to address the research questions. These theories showing how environmental science teachers integrate social justice themes were fully presented in Chapter Four and will be discussed in the next section.

Connection to the Literature Review

The use of case studies, making local connections, the importance of college experiences, and environmental literacy are four theories that emerged from the survey and interviews of this phenomenological research study. These phenomena were used to address the research questions and are ways AP Environmental Science educators incorporate social justice themes in their classrooms. Each theory will be addressed with support from the literature review in Chapter Two.

Case Studies

Early environmental science education for students included nature study, outdoor play, and exposure to wilderness areas (Comstock, 1911; Hungerford & Volk, 1990). Environmental education emphasized ecological knowledge and skills as necessary for the pro-environmental development of people who would then ultimately take positive action to preserve the environment (Kollmuss & Agyeman, 2002). Wals, Brody, Dillon, and Stevenson (2014) described how environmental education emerged from the pairing of ecological knowledge with the concerns to environmental threats, such as food scarcity, malnutrition, and the loss of biodiversity. These are similar topics discussed during the interviews that can be addressed through case studies and are also informed by the identity and diversity domains of Teaching Tolerance (2020).

My participants discussed the importance and relevance of case study in their classrooms. Stern, Powell, and Hill (2013) described the benefits of case study and real-world applications so students can make connections between what they are learning and the environmental issues facing their local community. As previously discussed in Chapter Two, environmental education is a call to action to confront global issues brought on by climate change. Issues such as extreme weather, famine, droughts, and high infant mortality rates disproportionately affect marginalized or minority communities (Beach, Share, & Webb, 2019; Pellow, 2018). As the Next Generation Science Standards include topics on sustainability (Krajcik et al., 2017), case studies can be a tool used to incorporate sustainability themes in an APES classroom setting (Stern, Powell, & Hill, 2013). My participants discussed using case studies on pollution, air quality, and communities residing near superfunds. These case studies provide students

with data and moments to discuss and reflect on how past environmental issues can be addressed today to avoid similar mistakes. Case studies also provide teachers a means to discuss the social and environmental injustices that occur in some parts of the world. As Howell and Allen (2017) concluded, students develop the motivation to help others and to make environmentally conscious decisions when global issues are framed through a social justice lens. Teachers in my study reported that case studies are a tool to do just that.

Local Connections

Similar to case studies, my participants also placed emphasis on including local connections within their curriculum. Local connections refer to designing curriculum and activities that include the communities that students live in. Monroe et. al (2019) described how important relevancy is in climate change education. In other words, by including information and case studies from their communities, students have a greater chance to connect with the material and find the relevance of the issue. For students to reach their full potential, it is necessary to connect students' backgrounds and prior experiences to social justice principles (Spitzman & Balconi, 2019) and the four domains of Teaching Tolerance (2020). This level of engagement was described by my interview participants. I heard about field trips and food deserts in local communities several times. I had participants describe their efforts to take their students to local landfills and superfunds so students could see firsthand how these areas look and feel. Participant #3 described her field trip to a local papermill so students could smell it directly and to see the lower income housing adjacent to the mill. Connecting topics to local communities helps engage the learner.

Including local connections is a tool for social change. As described in Chapter Two, Hackman (2005) explained that hope, positivity, and creative energy are foundations of social justice education. Wolf (2011) described empowering students to confront issues created by climate change. Dover (2013) described the importance of reflection to acknowledge, challenge, and change inequalities when observed. All of these areas can be included through local community activity, activism, and justice (Teaching Tolerance, 2020). Many of my participants spoke fondly of how they lead the sustainability or environmental clubs at their schools. Within these programs, teachers are able to address local concerns and integrate initiatives that improve their schools and local communities. They spoke of recycling programs, park cleanups, and food deserts. Bang et al. (2017) advocated for the NGSS to include more moments of equitable and engaged learning experiences to increase awareness and concerns for local communities. While none of my participants mentioned anything about the standards, they are certainly incorporating local communities to provide meaningful, challenging, and engaging science for all students.

College Experience

Along with case studies and local connections, many of my participants described their experiences in college as being instrumental for their journey into environmental education and affinity to social justice. Most of my participants had either an inspirational professor or instrumental environmental science class that acted as a catalyst to their interest in environmental education. While the survey conducted by the NCSE and Pennsylvania State University concluded that many teachers felt unprepared to teach climate change science (Plutzer et al., 2016), this was not the case for my study. My

participants reported that they felt prepared to teach the science behind climate change and also desired more professional development and training. Differing again from the NCSE report, my participants did not feel any pressure from families, administrators, or community leaders not to teach climate change. I believe this occurred because of their strong affinity to social justice and the environmental justice movement.

While in college, many of my participants described moments when they were involved in campus activism. This included the Black Lives Matter movements, demonstrations for women's rights, and climate change marches. These initiatives carried into their teaching careers and are grounded in the action domain of Teaching Tolerance (2020). These experiences of fighting for the marginalized or fighting for the benefit of the Earth has created a system for my participants to avoid the obstacles to effectively teaching climate change as described by Branch, Rosenau, and Berbeco, 2016). To review, these obstacles were also described by Plutzer et al. (2016) and include the pressures not to teach climate change, the lack of adequate climate change knowledge and training, and confronting the misconception that climate change is caused by natural processes. I did not observe any of these obstacles with any of my interview participants, and this can be attributed to social justice interests and experiences.

As described in Chapter Two, Teaching Tolerance (2020) has published a set of social justice standards teachers may use in their teaching. These domains include identity, diversity, justice, and action. While I will not review these domains entirely again, I would argue that these domains are inexplicably connected to the environmental justice movement and should be included in teacher preparation programs in college. Identity may include environmental positionality development, diversity is celebrating

the gifts of others, justice is recognizing diversity, hidden biases, and stereotypes, while action refers to students standing up for prejudice and injustices they observed and felt. My participants spoke of how instrumental college was for their environmental positionality today. Most spoke of how their childhood experiences laid the foundation for their connection to the environment. It was during college that the social justice movement became more cogent, and my participants decided to act on the prejudices and injustices they observed or felt. Furthermore, my participants described how these social justice feelings merged with their strong affinity to the environment. I would argue a clear implication of my study is to include moments of environmental justice in science education programs so future teachers have the opportunity to integrate social justice in their environmental curriculum.

Environmental Literacy

The last major theme that emerged from my study is the development of environmental literacy. For teachers to meet the requirements of the Next Generation Science Standards, focusing on student literacy is imperative. Students must be able to interpret data and evidence, engage in arguments, and communicate information to be effective scientific scholars (NGSS Lead States, 2013). Throughout the interviews, my participants spoke of how they require their students to read case studies, create and interpret data, and reflect on topics covered in class. These are examples of content mastery (Hackman, 2005) and can be conducted through the four domains of Teaching Tolerance. Connecting to my study, case studies are about inequities in local communities, the data is examining how pollution affects people differently, and

reflections are done through writing and sharing personal experiences. Being environmentally literate can be done through an environmental justice lens.

As previously noted, content mastery is not enough to be environmentally literate. As Orr (1992) explained while ecological literacy begins at an early age, students must learn to read and write critically about complex environmental issues. According to my participants, no complex environmental issue is greater than climate change and the intersection of sustainability with environmental justice.

Environmental justice, according to Pellow (2018) is the disproportionate burden of environmental harm felt by indigenous and marginalized communities. Environmental justice has its roots in the Civil Rights movements and is more relevant today than ever before. In college, I was a science and education major and environmental justice was not part of my vocabulary. I was not introduced to it until much later, during a climate change rally. While I am proficient in scientific literacy, I was greatly lacking in my social justice development. I did not know how concretely environmental justice and global sustainability are linked. My participants were largely aware of the link between sustainability and environmental justice and that sustainable societies are created when equality is reached within their societies. Several of my participants mentioned using the Sustainable Development Goals of 2020 in their classrooms. These goals were created to recognize and acknowledge the global inequalities of shared resources and access to education and healthcare, gender equality, and so on. My participants address these goals and give their students opportunities to read about, discuss, and reflect on their identities while inspiring action to address them.

Conclusion

While this section was not an exhaustive review of the literature, it was used to show that my participants integrate social justice in their classrooms through case studies, local connections, college preparedness, and environmental literacy practices. My participants showed explicit moments where each of these themes were demonstrated and supported by current environmental education literature. At the conclusion of the study, several implications have been noted and will be briefly discussed next.

Implications of this Phenomenological Study

My study builds upon the continual evolution of environmental education and offers insight to the connection between environmental education and social justice while addressing climate change. Although an exhaustive review of environmental education was beyond the scope of this dissertation, my study does offer suggestions to improve the field and make moments of environmental justice more explicit in teacher training programs and the AP curriculum.

Case studies and local connections are strategies my interview participants utilize to incorporate social justice when teaching their courses. Furthermore, all teachers in my study reported the integration of climate change throughout their AP course. However, how and to what extent this is used is subjective and dependent on the individual teacher's attitudes and efforts. Therefore, my first suggestion for future researchers is to properly define how case studies are used and to what extent local communities are brought into the AP curriculum. This level of consistency may help move the environmental justice movement forward in the high school environmental science curriculum.

Along with case studies and local connections, I do recommend teacher training programs evaluate the integration of environmental justice throughout environmental education programs while discussing climate change. My participants routinely discussed how instrumental their college experiences were in their own pro-environmental and social justice behaviors. I was surprised by these findings as my own college experience was not equivalent. This may be explained by our age differences and the lack of social justice inclusion when I was in college. I relied heavily on my childhood experiences to form my values while my college experience provided the content knowledge. It was not until I was an adult, with my own children, that I made the connection between social justice and the environment.

Lastly, my study reaffirmed how important environmental literacy is in the development of conscious environmental justice attitudes in our students and society. The literature is clear: science educators play a vital role in fostering pro-environmental behaviors within their students (Howell, 2013; Hungerford & Volk, 1990, Kollmuss & Agyeman, 2002). Even with the individual barriers that hinder PEBs discussed in Chapter Two, teachers must continue to stress sustainability and include climate change throughout their curriculum. Thinking, interpreting, and communicating like a scientist is critical as environmental educators continue to learn how to incorporate social justice themes in their classrooms. I believe it is important to note that pro-environmental behavior development dominated my literature search and review. However, none of my interview participants even mentioned the pro-environmental behavior development of their students. Rather, the development of the concern for others was heard over and over. This may imply the shift of environmental education from PEBs development

focused on outdoor experiences towards a social justice worldview. The interviews were dominated by altruistic moments and how individuals can collectively help others make the environment a better place.

Limitations of this Phenomenological Study

Several limitations of this study do exist. As described by Creswell (2007), phenomenological studies are based on the lived experiences of individuals. The intent of my study was to determine to what extent climate change and social justice concerns are integrated in AP Environmental Science classrooms. I was limited by the participants who chose to take part in my study. My participant pool was limited to members of the APES Facebook group who checked this page and responded to my survey. Therefore, the participants who chose to participate in my social justice study may already have a strong bias towards social justice and that is why they chose to participate. The teachers who did not click on my survey link may not prioritize social justice inclusion in their classrooms. Therefore, my participants may have introduced their own biases in my study.

Along with participant bias, I may also have introduced my own biases towards social justice in my classroom. As Charmaz (2006) indicated, grounded theory is predicated on the views, values, beliefs, and assumptions of the researcher. Therefore, my conclusions may be based on my own biases of how I include social justice in my own classroom setting. Efforts used to mitigate this included using a survey partly informed by other researchers, but biases may have been difficult to completely eliminate. For example, I use case study and local examples of environmental justice throughout my

APES course and was acutely aware of these practices during the interview processes. My biases may have influenced the coding process.

Another limitation of my study is the limited participants and time frame constraints I was under to complete this dissertation. As both environmental education and social justice are extremely complicated and involved topics, more research participants at more locations would be recommended to ensure the validity of these results as qualitative research is subjective to the researcher's interpretation of the data. Furthermore, collecting both gender, ethnicity, and location data of my survey participants may have been useful information to see any discrepancies between gender, location, and the inclusion of social justice and climate change education practices. While all of my participants identified as female, ethnicity demographics were not collected which remains a significant limitation.

Recommendations for Further Research

There are several recommendations to continue this research and add to the environmental education field. As previously indicated, the number of participants and their prior biases may have influenced the results of this study. Therefore, it is recommended to future researchers to increase the number of participants. To minimize potential biases, it is recommended to encourage all participants to take part regardless of prior social justice experiences. Although I did not purposely ask only for participants who include social justice in their curriculum, the title of my survey and posts on Facebook might have dissuaded some participants. APES teachers who do not incorporate social justice themes are missing from this study.

All of the data collected are personal accounts of social justice inclusion in environmental education. However, the data collected is not quantifiable. Therefore, a much deeper ethnographic study is recommended of the research participants. Follow-up visits, classroom observations, and a curriculum analysis would all be suggested follow-up studies to determine if social justice inclusion results in an increase in testing scores or community engagement and activism. My participants all reported that they do include social justice in their classroom and make environmental justice a priority through case studies, local examples, and efforts to increase environmental literacy. Observing these in action would add to the research field.

A final recommendation to advance this topic is to determine how my participants continue to develop their social justice affinity and inclusion through professional development. While this study answered how social justice is included and significant life experiences, such as outdoor play and college programs, were addressed, I did not address how teachers are continuing their education and training on this topic. My participants had strong personal connections to my topic, but I never asked how they continue their education or affinity to social justice concerns. I believe specific professional development is critical to this field.

Plans for Communicating and Using the Results

My results will be published through Hamline University and this work is public scholarship. Future plans will be to present my findings at regional and national conferences through the independent boarding school organizations my current school belongs to. I also hope to publish my findings and to write for a local conservation magazine published in Minnesota. This periodical accepts articles written by outdoor

enthusiasts and often contains educational materials. This would be my first attempt at publishing an article directly relating to environmental education and social justice.

I hope my results are useful for targeted professional development connecting environmental education and social justice. My data shows that my participants include social justice in their classrooms and are fluent in environmental justice. While their significant life experiences have brought them to this understanding, this might not be the case for all science educators. Therefore, my results can be used to demonstrate the need for directed environmental justice professional development for all teachers. Social justice is relevant and well-documented, but examples of environmental injustices are not yet part of the narrative among all teachers and students.

Final Reflection

Environmental injustice is a global pandemic. We live in a world where social injustices dominate the news and social media sites. However, I think back to working the gardens with my father as a child. I think back to the trees I climbed, the forests I hiked, and lakes I explored. These are the ecosystems that are threatened by a changing climate caused by humans. I also now think of the social injustices that I see every day and understand how those who are marginalized, threatened, or poor feel the burden of a changing climate much more than I do. As a child, social justice was not part of my vocabulary nor was it embedded in my actions like it is today. Today, more so than ever, environmental justice is needed. Students need the scientific background to debunk the false narrative that climate change is not real as the climate change science is clear. We must address it through our national standards. We must also frame it through altruistic values and sustainable practices, as what is good for an individual is good for a

community. Most importantly, we must instill hope to be good people in this terrible and beautiful world.

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APPENDIX A

Social Justice Standards by Teaching Tolerance

Anchor Standards and Domains

IDENTITY

1. Students will develop positive social identities based on their membership in multiple groups in society.
2. Students will develop language and historical and cultural knowledge that affirm and accurately describe their membership in multiple identity groups.
3. Students will recognize that people's multiple identities interact and create unique and complex individuals.
4. Students will express pride, confidence and healthy self-esteem without denying the value and dignity of other people.
5. Students will recognize traits of the dominant culture, their home culture and other cultures and understand how they negotiate their own identity in multiple spaces.

DIVERSITY

6. Students will express comfort with people who are both similar to and different from them and engage respectfully with all people.
7. Students will develop language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups.
8. Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way.
9. Students will respond to diversity by building empathy, respect, understanding and connection.
10. Students will examine diversity in social, cultural, political and historical contexts rather than in ways that are superficial or oversimplified.

JUSTICE

11. Students will recognize stereotypes and relate to people as individuals rather than representatives of groups.
12. Students will recognize unfairness on the individual level (e.g., biased speech) and injustice at the institutional or systemic level (e.g., discrimination).
13. Students will analyze the harmful impact of bias and injustice on the world, historically and today.
14. Students will recognize that power and privilege influence relationships on interpersonal, intergroup and institutional levels and consider how they have been affected by those dynamics.
15. Students will identify figures, groups, events and a variety of strategies and philosophies relevant to the history of social justice around the world.

ACTION

16. Students will express empathy when people are excluded or mistreated because of their identities and concern when they themselves experience bias.
17. Students will recognize their own responsibility to stand up to exclusion, prejudice and injustice.
18. Students will speak up with courage and respect when they or someone else has been hurt or wronged by bias.
19. Students will make principled decisions about when and how to take a stand against bias and injustice in their everyday lives and will do so despite negative peer or group pressure.
20. Students will plan and carry out collective action against bias and injustice in the world and will evaluate what strategies are most effective.

APPENDIX B

Environmental Justice Guiding Principles

WE, THE PEOPLE OF COLOR, gathered together at this multinational People of Color Environmental Leadership Summit, to begin to build a national and international movement of all peoples of color to fight the destruction and taking of our lands and communities, do hereby re-establish our spiritual interdependence to the sacredness of our Mother Earth; to respect and celebrate each of our cultures, languages and beliefs about the natural world and our roles in healing ourselves; to ensure environmental justice; to promote economic alternatives which would contribute to the development of environmentally safe livelihoods; and, to secure our political, economic and cultural liberation that has been denied for over 500 years of colonization and oppression, resulting in the poisoning of our communities and land and the genocide of our peoples, do affirm and adopt these Principles of Environmental Justice:

The Principles of Environmental Justice (EJ)

- 1) **Environmental Justice** affirms the sacredness of Mother Earth, ecological unity and the interdependence of all species, and the right to be free from ecological destruction.
- 2) **Environmental Justice** demands that public policy be based on mutual respect and justice for all peoples, free from any form of discrimination or bias.
- 3) **Environmental Justice** mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things.
- 4) **Environmental Justice** calls for universal protection from nuclear testing, extraction, production and disposal of toxic/hazardous wastes and poisons and nuclear testing that threaten the fundamental right to clean air, land, water, and food.
- 5) **Environmental Justice** affirms the fundamental right to political, economic, cultural and environmental self-determination of all peoples.
- 6) **Environmental Justice** demands the cessation of the production of all toxins, hazardous wastes, and radioactive materials, and that all past and current producers be held strictly accountable to the people for detoxification and the containment at the point of production.
- 7) **Environmental Justice** demands the right to participate as equal partners at every level of decision-making, including needs assessment, planning, implementation, enforcement and evaluation.
- 8) **Environmental Justice** affirms the right of all workers to a safe and healthy work environment without being forced to choose between an unsafe livelihood and unemployment. It also affirms the right of those who work at home to be free from environmental hazards.
- 9) **Environmental Justice** protects the right of victims of environmental injustice to receive full compensation and reparations for damages as well as quality health care.
- 10) **Environmental Justice** considers governmental acts of environmental injustice a violation of international law, the Universal Declaration On Human Rights, and the United Nations Convention on Genocide.
- 11) **Environmental Justice** must recognize a special legal and natural relationship of Native Peoples to the U.S. government through treaties, agreements, compacts, and covenants affirming sovereignty and self-determination.
- 12) **Environmental Justice** affirms the need for urban and rural ecological policies to clean up and rebuild our cities and rural areas in balance with nature, honoring the cultural integrity of all our communities, and provided fair access for all to the full range of resources.
- 13) **Environmental Justice** calls for the strict enforcement of principles of informed consent, and a halt to the testing of experimental reproductive and medical procedures and vaccinations on people of color.
- 14) **Environmental Justice** opposes the destructive operations of multi-national corporations.
- 15) **Environmental Justice** opposes military occupation, repression and exploitation of lands, peoples and cultures, and other life forms.
- 16) **Environmental Justice** calls for the education of present and future generations which emphasizes social and environmental issues, based on our experience and an appreciation of our diverse cultural perspectives.
- 17) **Environmental Justice** requires that we, as individuals, make personal and consumer choices to consume as little of Mother Earth's resources and to produce as little waste as possible; and make the conscious decision to challenge and reprioritize our lifestyles to ensure the health of the natural world for present and future generations.

More info on environmental justice and environmental racism can be found online at www.ejnet.org/ej/

Delegates to the First National People of Color Environmental Leadership Summit held on October 24-27, 1991, in Washington DC, drafted and adopted these 17 principles of Environmental Justice. Since then, the Principles have served as a defining document for the growing grassroots movement for environmental justice.

APPENDIX C

Interview Questions

1. How has your school year been thus far?
2. Please tell me how long have you been teaching and what subjects do you currently teach?
3. What are your concerns about climate change?
4. Do you teach about climate change?
5. Please describe the significant life experiences and formative influences which have contributed to your concern about climate change.
6. What are the top three topics that you like to cover in your AP environmental science course?
7. Referring to question #5, what teaching strategies do you employ?
8. In what ways do you incorporate social justice in your classroom?
9. Describe an example of an activity or assignment that includes social justice themes.
10. How does your understanding of social justice concepts impact your understanding of environmental issues?
11. What are the biggest threats to the environment?
12. What do you hope your students accomplish in your class?

APPENDIX D

Consent Form



Hamline University
Institutional Review Board has approved this consent form.
IRB approval # 2021-01-132E
Approved: 1/5/2021

Informed Consent to Participate in Research

You are being asked to participate in a research study. This form provides you with information about the study. The student researcher or faculty researcher (Principal Investigator) will provide you with a copy of this form to keep for your reference and will also describe this study to you and answer all of your questions.

This form provides important information about what you will be asked to do during the study, about the risks and benefits of the study, and about your rights as a research participant.

- If you have any questions about or do not understand something in this form, you should ask the research team for more information.
- You should feel free to discuss your potential participation with anyone you choose, such as family or friends, before you decide to participate.
- Do not agree to participate in this study unless the research team has answered your questions and you decide that you want to be part of this study.

- Your participation is entirely voluntary, and you can refuse to participate or withdraw at any time.

Title of Research Study: Mitigating Climate Change: Understanding How Teachers Integrate Social Justice Themes in Environmental Education

Student Researcher and email address: Gregory A. Simons, Jr.,
gsimons01@hamline.edu

Faculty Advisor: Dr. Patty Born Selly, Assistant Professor Hamline School of Education, Hamline University, pselly01@hamline.edu

1. What is the research topic, the purpose of the research, and the rationale for why this study is being conducted?

The integration of social justice inclusion in environmental education is the topic for this qualitative study. The specific purpose of this research study is to determine how self-identified environmental science educators integrate social justice themes in their classrooms. Environmental science education has included several techniques to encourage pro-environmental behaviors from students. Recent literature suggests the importance of the inclusion of social justice themes in environmental education classrooms as a means of developing pro-environmental behaviors. Therefore, the rationale of this study is to determine what this looks like and how it is done through the primary research question: How do environmental science educators integrate social justice themes in their classrooms? Furthermore, the secondary research question of this study is: How has environmental education evolved to incorporate climate change education?

2. What will you be asked to do if you decide to participate in this research study?

Potential research participants will come from the AP Environmental Science Facebook group. Through a public post, participants will be asked to voluntarily complete a confidential survey through Google Forms. This survey is voluntary and will be posted twice, approximately a week apart. No identifiers will be used during the survey. At the conclusion of the survey, participants will be given the chance to provide contact information if they would like to participate in an interview with the researcher to dig deeper into social justice inclusion within their AP environmental science class. The researcher will follow up with each individual. Interviewer, Greg Simons, will provide a Zoom link to each person selected to interview. The interview may take place in a location most comfortable for the interviewee. The interview will last approximately 30-45 minutes at a convenient time for the participant. The interview questions and consent form will be emailed to the interviewee ahead of time. The interview will be recorded for preservation of the audio only. Therefore, the participant is not required to turn on his/her video camera during the interview. The interviewee's name, location, and other identifiers will be given pseudonyms in the transcript of the interview to protect the interviewee's identity. A copy of the transcript will be offered to the interviewee prior to completion of the dissertation.

3. What will be your time commitment to the study if you participate?

The survey will take approximately 10 minutes to complete. Survey participants who choose to provide contact information, and then subsequently selected, will

participate in a single survey lasting 30 to 45 minutes. Participants will be informed that a follow-up email with additional questions may occur.

4. Who is funding this study?

This is not a funded research study.

5. What are the possible discomforts and risks of participating in this research study?

By participating in this study, there is a small chance of personal discomfort since we will be discussing topics surrounding social justice and equity. Answering direct, unstructured questions regarding social justice may cause potential discomfort. This may result in a loss of confidentiality and steps will be taken to minimize those risks as described below. In addition, there may be risks that are currently unknown or unforeseeable. Please contact me at gsimons01@hamline.edu or my faculty advisor Patty Born Selly at pselly01@hamline.edu to discuss this as you wish.

6. How will your privacy and the confidentiality of your data and research records be protected?

The information collected by the survey will be stored on Hamline's secure Google Drive. Furthermore, recordings and interview transcripts will also be stored on Hamline's secure Google Drive for the duration of the study. Names and other identifying information (such as schools, districts, or program names) will be changed and pseudonyms will be used to protect the identity of all participants. Furthermore, participants will be offered a copy of the transcript at the completion of the interview for their review to ensure anonymity. Upon completion of the dissertation process, all

electronic and any paper copies made of transcripts will be destroyed and deleted from Hamline's Google drive.

7. How many people will most likely be participating in this study, and how long is the entire study expected to last?

The number of survey respondents is unknown due to the size and volume of posts on the AP Environmental Science Facebook group. However, 5-7 people will be randomly selected as interview participants. The duration of the study will last from January 2021 to March 2021. Interested interview participants will be selected via random sampling methods. Each interested participant will be recorded and assigned a random number. Selection will take place using a table of random numbers for a total of five to seven participants.

8. What are the possible benefits to you and/or to others from your participation in this research study?

Mitigating climate change is a global environmental issue with social implications. Participating in this study may give the interviewee time to reflect on his/her social justice inclusion in his/her classroom. Furthermore, the conclusion and implications gleaned from this study will result in social justice resource sharing for the field of environmental education. Environmental educators may use this study to get ideas and teaching practices to include social justice themes in their classroom. Lastly, a clear benefit for participants is the opportunity to reflect on professional practice and new learning that will take place during the interview.

9. If you choose to participate in this study, will it cost you anything?

There is no cost to participate in this study.

10. Will you receive any compensation for participating in this study?

Participants will not be compensated for participation in the survey. Those who volunteer and are selected for the interview will be provided an electronic Amazon gift card for a total of \$10.00 for their time.

11. What if you decide that you do not want to take part in this study? What other options are available to you if you decide not to participate or to withdraw?

Your participation in this study is entirely voluntary. You are free to refuse to participate in the study, and your refusal will not influence your current or future relationships with Hamline University. In addition, if significant new findings develop during the course of the research that may affect your willingness to continue participation, we will provide that information to you.

12. How can you withdraw from this research study, and who should you contact if you have any questions or concerns?

You are free to withdraw your consent and stop participation in this research study at any time without penalty or loss of benefits for which you may be entitled. If you wish to stop your participation in this research study for any reason, you should tell me, or contact me at gsimons01@hamline.edu or my faculty advisor, Patty Born Selly at pselly01@hamlin.edu. You should also call or email the Faculty Advisor for any questions, concerns, suggestions, or complaints about the research and your experience as a participant in the study. In addition, if you have questions about your rights as a

research participant, please contact the Institutional Review Board at Hamline University at IRB@hamline.edu.

13. Are there any anticipated circumstances under which your participation may be terminated by the researcher(s) without your consent?

None anticipated. Upon completion of the interview, you will be provided an electronic Amazon gift card for a total of \$10.00 for your time.

14. Will the researchers benefit from your participation in this study?

The researcher will gain no benefit from your participation in this study beyond the publication and/or presentation of the results obtained from the study, and the invaluable research experience and hands-on learning that the students will gain as a part of their educational experience.

15. Where will this research be made available once the study is completed?

This research is public scholarship, and the abstract and final product will be cataloged in Hamline's Bush Library Digital Commons, a searchable electronic repository. This dissertation may be published or used in other ways, such as in conference presentations or published in research journals.

Signature Page

As a representative of this study, I have explained the purpose, the procedures, the benefits, and the risks that are involved in this research study:

_____	_____
Signature and printed name of person obtaining consent	Date

_____	_____
Title of person obtaining consent	Date

You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this Form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time. You voluntarily agree to participate in this study. By signing this form, you are not waiving any of your legal rights.

_____	_____
Printed Name of Participant	Date

_____	_____
Signature of Participant	Date

_____	_____
Signature of Principal Investigator	Date