Case Study: Evaluating Teaching and Environmental Literacy Education in Alameda Unified School District Middle Schools

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ABSTRACT

Although there is scientific consensus about the anthropogenic causes of climate change, public and political debate inhibits the necessary immediate, aggressive and unified action that needs to be taken against this global crisis. This continued debate evidences that the public lacks the essential critical thinking skills necessary for informed and responsible decision making and underlines the imperative to invest in environmental literacy education. Environmental literacy education cannot only radically shift our population's attitude towards global warming, but can also equip the next generations with the skills they will need to solve the problems of the future. This study investigates the implementation of environmental literacy education in the Alameda Unified School District (AUSD) by conducting interviews with middle school teachers in the district and using classroom surveys to assess the students' level of environmental literacy. The AUSD is one of 19 districts in California to implement an environmental literacy curriculum in K - 12 schools. This study will explore the challenges associated with teaching environmental literacy education in an interdisciplinary context as well as understanding what qualities, attributes and behaviors are critical for environmentally literacy.

KEYWORDS

environmental knowledge, environmental attitude, informed behavior, environmental psychology, ideology, climate change denialism, skepticism, public education, media

INTRODUCTION

Despite that millions of people around the world are experiencing the effects of climate change first hand, there are still debates about the causes and courses of action needed to address this issue (NASA 2019). In addition to this lack of political consensus, ideological divisions and fragmented narratives impede the momentum of political processes and movement towards progressive climate action (Lakoff 2010). Because competing information between the scientific and climate skeptic communities has created a political quagmire of environmental inaction, it is important that we educate our citizens how to be critical consumers of these different messages. Federal programs like the National Aeronautics & Space Administration (NASA), the National Oceanic & Atmospheric Administration (NOAA) and the National Science Foundation (NSF), as well as state-level education programs, such as the Maryland & Delaware Climate Change Education Assessment & Research (MADE CLEAR), all agree that the first necessary step towards combating climate change is creating an environmentally literate community (MADE CLEAR 2015, Cooper 2011). Research shows that even a foundational knowledge of environmental issues and trust in scientific bodies does not correlate with responsible consumer choices and environmentally conscious decisions (Maibach et al. 2009).

Other research has shown that environmental knowledge is not significantly different between climate change acceptors and climate change skeptics, thus evidencing that climate skeptics don't necessarily have a deficit of scientific knowledge and that increasing one's knowledge of environmental issues does not necessarily correspond with environmentally responsible behavior (Braman et al. 2012). Based on their surveys, these researchers also found that rejection of climate data is an objection to egalitarian views, or a strive towards community equality and equal opportunity. This illustrates that people's political values, and whether they prioritize the health of the community or that of the individual, also affects public perception of this issue (Braman et al. 2012). This suggests that knowledge and understanding of global warming does not represent the entirety of the communication gap between the scientific and non-scientific communities. Therefore, in order to move past the ideological and political barriers that generate discordance in the climate change community, we need to restructure our cognitive frameworks for understanding these issues and adopt a radical stance towards our relationship with the environment (Lakoff 2010).

Because environmentally responsible behavior does not solely depend on the breadth of environmental knowledge that one has, an environmental literacy curriculum should also seek to encourage environmental engagement. Currently, environmental behaviors and actions are not assessed for in school districts that have implemented environmental literacy programming. According to the California Environmental Literacy Education Blueprint, developed by State Superintendent of Public Instruction Tom Torlakson and the Environmentally Literate Task Force (ELTF), environmental literacy education in California should aim to do the following:

> "Through lived experiences and education programs that include classroom-based lessons, experiential education, and outdoor learning, students will become environmentally literate, developing the knowledge, skills, and understanding of environmental principles to analyze environmental issues and make informed decisions." (ELTF 2015)

Although these efforts to implement this curriculum have been gradual, there is still no current research being done in my study site, the AUSD, to assess these behavioral components of environmental literacy. For these reasons, this study will aim to understand how the behaviors and actions of environmentally literate individuals correspond to their education. In other words, I will be assessing how environmental literacy curriculum might impact students' environmentally literate behaviors.

Defining Environmental Literacy

Defining environmental literacy is important because in order for instructors, politicians, school faculty, non-profit organizations and other groups to implement environmental literacy programming into schools, they will have a framework to outline their work and a set of goals to use as a metric for accountability. While much of the theory around environmental literacy converges on similar characteristics of literacy, there is no standard definition.

Despite that there are several kinds of literacy, ranging from topics like media literacy to marine science literacy, educators and researchers across disciplines tend to converge on what characteristics are necessary for literacy. Taking all of these various types of literacy into account can help generate a more complete picture for what cognitive and behavioral characteristics make an individual 'literate.'. Various programs, whether this be state-wide educational programming

or private organizations, all tend to describe 'literacy' as an ability to learn how to tell what information is reliable, learn to question the legitimacy of digital images and figures, understand how our individual use has direct consequences to the larger world, and diversify sources of information (Wan et al. 2008). Furthermore, literacy is often understood as being able to adopt multiple viewpoints and relationships with texts, thus developing an interdisciplinary understanding of the subject (Gal 2002).

This implies a self- awareness and critical consumption, such as the ability to analyze content info, identify credible sources of information and understand different actors' (e.g. government, private firms) roles and relationships in these projects (Wan et al. 2008). It is important to understand these definitions of literacy so that we can hold the developed curriculum accountable to its aims and learning goals.

Environmental Literacy v. Environmental Knowledge

Environmental literacy differs from environmental knowledge in that it involves action, responsible consumerism, critical thinking, communication, values and beliefs (Nadkarni et al. 2019, Cooper 2011, ELTF 2015). The Global Climate Research Program defines an environmentally literate person as, "Someone who knows how to assess scientifically credible information, communicates climate change in meaningful ways, able to make informed and responsible decisions with regards to how they might impact the climate" (Veron et al. 2016).

It is important to distinguish environmental literacy from environmental knowledge because many current science education models align with the deficit perspective, which is the idea that a certain individual has a lack of knowledge about the environment (Cooper 2011). According to this study, this model of education is not only ineffective at making an individual more environmentally literate, but it also doesn't teach individuals how to think critically and debunk misconceptions and misinformation about climate change (Cooper 2011). Therefore, when educators teach environmental literacy, they need to advance students' critical thinking skills and climate action behavior. These characteristics will carry over in the long-term of an individual's lifetime and equip them with the necessary tools to navigate the information about climate change in an informed and responsible manner.

Despite that many may use the terms 'environmental knowledge' and 'environmental literacy' interchangeably, it is important to distinguish that environmental knowledge is a necessary component for environmental literacy but that it is not a complete picture. This is why we need models of science education that do not only prioritize environmental knowledge but also uplift the cognitive, behavioral, emotional, participatory and critical thinking components that characterize environmental literacy and make up a environmentally-responsible, informed and motivated individual. While these characteristics are the most impactful for climate action, they are not easily defined, measured or assessed, which is why I will go into further detail how I will define environmental literacy for the context and purpose of this study. The list of environmental literacy traits that I will be testing for in this study are listed below in Table 1.

Table 1. Tested Characteristics of Environmentally Literate Individuals. List of characteristics of literacy that will be investigated and assessed in this study.

BEHAVIOR	COGNITIVE	ATTITUDE
• Civic engagement and participation	• Knowledge and Awareness	• Belief in Individual Impact
• Communication	• Critical Thinking	• Motivated Hope and Concern
• Informal Education	• Identify Credible Sources of Info	• Perception of Environment

Table 1 Lists several characteristics that I hypothesize are necessary for environmental literacy. Other studies tend to prioritize one of these nine characteristics and only briefly mention the others in the 'future directions' section (Shih-Wu et al. 2018, Nadkarni et al. 2019). For the purpose of my study, I will define each of these characteristics in relation to other research and the AUSD's literacy goals.

Characteristics of Environmental Literacy

a). Knowledge & Awareness

A basic level of knowledge about the environment, climate change and human impacts on the environment is essential for supporting climate change mitigation work and advocacy (Cooper 2011). If people do not have accurate and abundant knowledge on climate change and its significance to societal health and well-being, then it is less likely that individuals will be able to navigate sources of information in a way that privileges accurate and informed global warming messaging (Cooper 2011). Additionally, there is research that shows that knowledge about the environment is not as important as the belief that global warming is anthropogenic (Braman et al. 2012). Other research suggests that people with a high awareness of climate change does not necessarily indicate one's acceptance of this information (Allum et al. 2008). This indicates science education should not only focus on scientific awareness and knowledge but also the other characteristics of literacy that will be explored in the rest of this paper.

b). Critical thinking

Critical thinking is different from knowledge and awareness because it accounts for students' ability to relate global climate change issues to their local environment and to understand the significance of these issues. Critical thinking also engages an analytical quality, allowing students to read, interpret and analyze information that is provided to them. Many studies show that a basic knowledge and awareness of environmental challenges is not enough to care about the environment, take environmental action or debunk myths and misconceptions of climate change (Allum et al. 2008, Cooper 2011, Braman et al. 2012). Therefore, if educators don't teach students critical thinking skills, then their students will graduate without having the ability to work against climate skeptic groups or foster a healthy and informed dialogue with the opposition.

Environmental narratives are often written and constructed in colonialist and imperialist language, however, environmental issues disproportionately affect low-income communities of color yet the environmentalist movement is seen to be led by white people and often disregards native knowledge and practices (Newkirk 2018). An example is that native fire prevention, which

involves regular burning, was often viewed as a savage technique by white foresters and environmentalists (Abrams and Nowacki 2019). By equipping students with critical thinking skills, they will be able to think through these misconceptions and understand the social and political consequences of perpetuating colonialist narratives such as these.

c). Perception of the Environment

Although 'Perception of the Environment' is a broad title, my main research concern here is to qualify how one's 'connectedness' to the environment might correspond with their concern or likeliness to take environmental action. One of the largest cognitive roadblocks that humanities scholars and ecocritical theorists take up in their studies is dualistic thinking and imagining humans and the environment as separate spaces (Cronon 1995). Therefore, narratives about environmental issues should work to actively dissolve this binary so that people can see that their human behavior has visible and tangible effects on the environment. In "The Trouble with Wilderness," Cronon argues that if we take a more critical gaze at what we believe to be "pristine" wilderness, we will see that nature does not exist without society; that both mutually construct each other and have boundaries that are permeable and non-exclusive (Cronon 1995). This dualistic thinking and othering of Nature as some non-human entity, is what Cronon claims leads people to have apathetic views towards nature and the global environment.

d). Belief in Individual Impact

Combating climate change is challenging because it demands significant public support in order to enact change. Other scientific issues that are local to industries or laboratories may not be as controversial because they do directly involve the public. Because climate change is a globally unifying, international threat, communicating climate science is challenging. In order to rally public support, the climate scientists must simplify their message for a large audience that encapsulates varying demographics and ideologies (Lakoff 2010). However, once scientific work enters the public discourse, it becomes difficult to separate it from misinformation; especially on the internet which has become a technological democracy of information, misleading and not (Lewandowsky et al. 2017).

Public pessimism can also demonstrate whether or not the public perceives risk in environmental degradation. The optimism bias, or what is also termed unrealistic optimism, is the phenomenon that people believe negative things are more likely to happen to others whereas positive things are more likely to occur to them (Jefferson et al. 2017). This bias can either be situational or dispositional, meaning that it is either formed from the circumstances of a given situation or this is an innate bias that a certain individual holds. When we look at how optimism bias operates on the level of a population, we see that the individual perceives less risk and danger to their immediate family or community than they do to the nation or the world (Hatfield and Job 2001). When applying this perspective to the issue of climate change, it becomes clear that individuals have a cognitive distance from the global scale of environmental degradation, hazards and dangers and that those who directly suffer the consequences of climate change are more likely to be acceptors of climate science (Singh et al. 2017). These psychological factors are important to consider because an individual's perception of danger may also indicate their concern about an environmental issue and their probability to take action.

e). Identify Credible Sources of Information

Children get more environmental information (83%) from the digital media than from any other sources such as books, peers, or conservation centers (Cooper 2011). Because children don't critically analyze media, they form their opinions based on which information occurs the most abundantly (Stahl et al. 1996). Therefore it is paramount that education teaches children how to critically engage and analyze media messages about global warming (Cooper 2011). Furthermore, because the media often depicts climate debates as happening between two scientists, audiences often perceive the climate denialists as having equal weight in this conversation when actually there is large scientific consensus about the existence of anthropogenic climate change (Boykoff and Boykoff 2004). By improving students' ability to identify credible sources of information, educators can empower their students to make informed decisions. Without this component of environmental literacy, we would be neglecting to address that students often educate themselves about the environment outside of the classroom space.

f). Informal Education

Although this study is aiming to understand how the district's programming impacts the environmental literacy of the students, it is important to acknowledge that students' self-education can impact their perception of the environment and thus their evaluation of climate change issues. By including this variable of 'informal education,' I am trying to account for the ways in which a student may educate themselves outside of the traditional classroom environment. While scientific knowledge is undoubtedly valuable for our understanding of climate change issues, it is countlessly proven that local knowledge is also incredibly valuable. A recent example of this is the Inuit people's documentary *People of a Feather* (2011), which shows how the Inuit people of the Chesapeake Bay understand the geological impacts of industrial water use to their local habitat before western scientists do. This is one illustration of how one can learn from their local, regional environment. I wanted to account for this variable as well because I think it is important to recognize this as a legitimate form of knowledge and to also recognize that students may have firsthand experience with environmental injustices that impact their perspective of climate change.

g). Communication

Narrative frameworks are so important for environmental literacy education because humans learn through story (Bruner 1991, White 1980, Cronon 1995). The way that we frame the issue of climate change can impact how threatening they perceive the issue to be, how motivated they are and how included they feel in this dialogue (Nisbet and Scheufele 2009). Therefore, it is important to teach students how to accurately and responsibly talk about this issue with others. Most climate science literacy assessments test for people's understanding of how global warming occurs and what are its causes, however few climate literacy assessments test people's ability to communicate this issue to others despite that this is a crucial step towards engaging the larger community in environmental issues. The narrative frameworks through which we communicate climate change politics also have significant impacts on how the public perceives climate change (Nisbet and Scheufele 2009).

h). Civic Engagement & Participation

Civic engagement and participation has also been shown to make students care about these issues, trust the science and advance their knowledge on these subjects (Lewenstein 2002). Furthermore, it has been shown that knowledge and awareness do not always precede environmental behavior and that engagement in a certain action or environmental behavior can be the catalyst for one to adopt other environmentally literate behaviors (McCallie et al. 2009). Such is demonstrated by the California Recycling Program in which students were taught how to recycle by having them first doing the action of recycling ("State Recycling Law" 2016). Therefore, by taking students on environmental trips, field trips and outdoor learning experiences, educators can activate and engage students' natural curiosity for the outside world and encourage them to pursue their knowledge further. Community engagement volunteer opportunities is also something that the AUSD advocates for within its own tenets of literacy (Environmental Literacy 2018).

i). Motivated Hope & Concern

In this study, I tested for scientific and governmental trust by gaging students' 'motivated hope & concern' (Table 1). Scientific and governmental trust is a prerequisite to believing that these institutions can make positive change on the global environment (Cooper 2011). Furthermore, without believing in the possibility of change, it is unlikely that students will view their own climate action as necessary or valuable. While the following may seem like a divergence from the thesis of this study, it is important to address the socio-political stakes of this kind of programming because this scientific history outlines why this curriculum might be contentious in more conservative districts of California, such as those in the Central Valley (Inverness 2019).

Skepticism is often regarded as healthy in the scientific community, it is only when this skepticism enters the public consciousness that it becomes a concern (Eubanks 2017). Skepticism is an interrogation of norms, it is stepping away from dogma, superstitions, overarching structures, etc. and revisiting their claims (Washington and Cook 2011). Recent political trends have led to authority distrust, which also consequently has extended to the scientific community (Eubanks 2017).

Denialism, comparatively, is a direct ignorance of evidence that has already been tested, peer-reviewed and critiqued thoroughly (Eubanks 2017). Like skepticism, denialism is multi-variable and has several types that will be explored later in this draft. Besides being a rejection of competing political ideologies (Lewandowsky et al. 2017), denial can also be initiated by apathy (Hatfield and Job 2001), and invested interests (Oreskes and Conway 2012).

Political actors and scientists are also under scrutiny because they both conduct their work in private spaces, away from the view of the public (Warner 2005). This inherently produces a sort of skepticism and perceived elitism because the public is not involved and integrated into the process of decision making or experimentation (Lewandowsky et al. 2017) . This private nature of science has been debated since the creation of scientific studies, dating back to debates as old as the 1600's between Hobbes and Boyle (Shapin and Schaffer 1985). Thus, while media, networks and inherent beliefs impact one's ability to reason about climate change, the very methods in which science is conducted have also historically produced skepticism of science.

Since the 1980's, when climate change was brought to the public's attention, public concern in climate change has hovered around 60% of American adults (Newport 2012). Fluctuations in public concern about climate change have changed since the 1980's, however, since the public does not use the same criteria as scientists to make an informed opinion on climate change (Newport 2012). Whereas scientists have expertise that is informed by technical, niche knowledge and peer review, public opinion is constructed by abundant media messaging, religion, political affiliation and other socio-political influences. Thus other variables, political, rhetorical, psychological, etc. are most likely impacting public concern.

While this history of science complicates this issue of environmental illiteracy, it is essential to address it in this paper since these socio-political challenges illustrate why this programming is necessary at all. If these challenges did not exist, we would have taken the necessary precautions against climate change when we were alerted about this global crisis. While environmental literacy education is not aiming to solve all of these institutional challenges simultaneously, by holding current educational models accountable to this history, we can soften the divide between the scientific and public bodies that prevents people from wanting to take climate action in the first place.

Current Science Education Models

a). Informal Science Education (ISE) and Public Understanding of Science (PUS)

While current environmental education efforts do increase an individual's awareness and knowledge of climate issues and concerns, many of these programs do not teach the necessary critical thinking skills that are necessary for understanding the debates about global warming (Cooper 2011). Informal science education, or ISE, and public understanding of science, or PUS, models are good examples of this ineffective approach towards climate change education. This study showed that ISE and PUS are not only ineffective but potentially harmful since these models fail to emphasize critical thinking, aligns with a deficit perspective, and exacerbates the policy gap as driven by intentional and unintentional influences at work in the media-laden world" (Cooper 2011). Furthermore, by teaching critical thinking and 'healthy skepticism' in an informal format, these models pose the risk of producing 'cynical and pessimistic thinkers' (Mihailidis 2009). Thus, environmental literacy education not only needs to be abundant but also clear, direct and comprehensive.

b). Public Engagement in Science (PES)

A more effective alternative to these environmental literacy education models is the public engagement in science model, or PES. PES aims to avoid the deficit model of PUS while also promoting public trust so that citizens make more responsible and environmentally conscientious decisions (Cooper 2011). By integrating the non-scientific public into scientific discussions and giving them the opportunity to engage with science, PES builds students' confidence and makes them feel that science is accessible (Cooper 2011). By instilling this confidence and accessibility in the non-scientific public, people are more likely to be willing to engage with environmental campaigns and ideas. This model of education aligns with much of the work that the AUSD is doing currently as I will elaborate on later in the paper.

Challenges of Teaching Environmental Literacy Education

To ensure that literacy curriculum plans are being appropriately developed and implemented, it is paramount that teachers help facilitate this communication between the material and the students while also maintaining the integrity of different definitions of 'literacy.' Teachers can instill literacy habits and abilities in students by teaching them how to be curious, explore, and ask questions about the information they are provided. This innovative and creative thinking is outlined in guidebooks for teachers and is encouraged by professional development groups like CAELI. Furthermore, because much of the Blueprint's environmental literacy programming aims to install more interdisciplinary methods of environmental literacy education, such as integrating conversations about the environment into history and social science curriculum, teachers without a technical science background need to be trained how to properly integrate environmental topics into their classrooms. This movement to implement interdisciplinary thinking between the sciences and the humanities is also met with a lot of opposition, and what former AUSD superintendent Sean McPhetridge calls 'balkanization,' since there are limited resources for these different programs (e.g. science, history, art) in the district. This resource-competition for funding these different programs has hindered the progress of integrating these subjects.

Other research suggests that teachers should also speak to these tenets of literacy explicitly and make the learning goals transparent to the students (Zales and Unger 2008). Ideally, teachers should be flexible and adaptive to curriculum changes and be able to learn how to apply 'formal' knowledge to the real world in ways that make these subjects digestible and understandable to students. One of the largest challenges with teaching the complex interdisciplinary ideas behind climate change is that teachers don't have time to talk about climate change because it's not the entire issue and focus of the class (Veron et al. 2016). Additionally, teachers are resistant to integrating climate change material into their existing lesson plans because they think that it detracts from the information that their students are graded on (Veron et al. 2016). To gain support from teachers, we must emphasize that integrating climate change literacy programming into existing material is valuable and necessary since it teaches students critical thinking skills that increase their performance in mandatory, state-tested classes (Veron et al. 2016).

Because teaching styles vary so widely at an individual level, many researchers and educators in this topic advocate for a system-wide change to establish the necessary resources for

schools. This also becomes important when considering the diversity of classrooms and the need to acknowledge that students will have different levels of accessibility and receptivity to certain materials (Cheruvelil and Ye 2012). Thus the difficulty of standardizing literacy philosophies demonstrates how challenging the implementation of this material can be, but also marks an opportunity for innovation and necessary change.

Environmental Literacy Education in the AUSD

As my study site, I will be looking at the environmental literacy curriculum AUSD middle schools, whose programming was published in 2015 by State Superintendent of Education, Tom Torlakson, and the Task Force team (Inverness 2019). Under *California's Blueprint for Environmental Literacy* (Blueprint 2015), the state of California is hoping to implement environmental literacy programming in History/Social Science and Science classrooms at every K - 12 public school in the state (Inverness 2019). Senate Bill 720 also helped to institutionalize this environmental literacy framework drafted by the Blueprint and California's Environmental Principles and Concepts (EP&Cs) into the state's Education Code (Inverness 2019). The curriculum for this programming was developed by the California Education and Environmental Initiative (EEI) and has continued to be revised and updated in accordance with Next Generation Science Standards (NGSS). Other environmental literacy groups in the Bay Area that have also contributed to the development of these education goals include Ten Strands, California Environmental Literacy Initiative (CAELI), the Lawrence Hall of Science, BaySci and ChangeScale (Inverness 2019). Similar environmental literacy programming has been introduced in Maryland and Colorado and in 2015, Governor Gavin Newsome mandated the implementation of environmental literacy curriculum in K - 12 schools across California.

To test this programming before implementing it to all public schools in California and sharing it with all 6.2 million public school students, 19 pilot districts have begun to uptake this curriculum, one of which being the Alameda Unified School District, or AUSD (Inverness 2019). AUSD serves approximately 9,500 students across several schools, including: "a pre-school, nine elementary schools, four middle schools, two comprehensive high schools, a continuation high school, an Early College High School, and an adult school" (Inverness 2019). While I had originally intended to survey students and interview teachers at all of these school sites in Alameda,

I was only able to collect data from the middle schools due to certain time and availability constraints that I will explore later in this paper.

While the demographic composition of this district will not be thoroughly investigated in this study, it is worthwhile to note that this district is considered to be a 'representative Californian community' as it has both high and low-income communities and a moderately racially diverse community (Inverness 2019). Despite that there are efforts to implement an environmental literacy curriculum in this district, there is not a standard practice for systematically integrating this programming into the AUSD (Inverness 2019). Environmental literacy education in this district is hoping to move beyond textbook education and include more field-trips, environmental experiences and student engagement, volunteering and participation.

This curriculum was developed primarily by the EEI, and its many partners. Its materials are up to date with Common Core State Standards (CCSS) and other state education mandates and principles. EEI promotes five principles of environmental literacy throughout its materials, these principles being:

1. People Depend on Natural Systems
2. People Influence Natural Systems
3. Natural Systems Change in Ways that People Benefit From and Can Influence
4. There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
5. Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

These principles address major misconceptions of climate change that prevent many from taking effective and necessary climate action. Some of these common misconceptions include binary thinking that distinguish humans from non-humans, devaluing the impact of individual behavior, and disregarding the role of policy and government in environmental work. As this study will explore, these misconceptions are important to address because they underline one's proclivity to take informed and responsible environmental action. Some of these principles were also used to structure my survey questions, as will be discussed later in this paper.

Alameda's Visions for Environmental Literacy Education

The state-wide protocols regarding environmental literacy education have influenced the ways in which the AUSD has set up their environmental literacy and Green Schools programming. This district defines its goals for environmental literacy education as follows:

> "Every student in Alameda will feel connected to the outdoors through regular and consistent field trips, access to service learning experiences, and integrated classroom and field-based experiences. Through scientific inquiry, critical thinking, and environmental know-how, students will graduate prepared to solve the world's problems."

This definition outlines much of the curriculum goals of the state of California and places a particular emphasis on individual impact, various forms of engagement, and informed decision making. This feeling of 'connectedness to the outdoors' and 'critical thinking' is difficult to quantify or assess as many of these characteristics are not suitable for standardizing testing. This outlines the objective of this study, which is to assess students' baseline literacy level and understand how this programming is affecting students in the district.

METHODS

Besides the extended literature review and analysis that comprises the bulk of my paper, I also conducted interviews with teachers and distributed surveys to middle school classrooms in the district. The purpose of the surveys was to establish a baseline for students' environmental literacy level; identifying how their knowledge of environmental issues might relate to their intent to act or their perception of the environment. The intent of the interviews was to give voice to the educators concerns, challenges and experience in the classroom. While the district at large may have many goals and visions for their teachers, some of these expectations may be unfeasible given the demands and time budget of the teachers. For these reasons, the interviews were intended to illuminate ways that the district could best support its teachers to teach environmental subjects more effectively.

This study will seek to assess students' baseline environmental literacy based on the definitions and goals set out by the AUSD and other surrounding environmental literacy research.

To test for this, I distributed 25 surveys to one sixth grade science classroom. The questions in this survey will seek to understand which environmental attitudes, knowledge and behavior are necessary for literacy (refer to Appendix H). Because participants were not financially compensated for this survey, the resulting responses were contingent upon participants' availability and generosity with their time.

Survey

On the survey, 30 of the 38 questions were conducted on a five-point Likert scale, one was short-answer, two were multiple-selection, two were multiple choice and three were demographic. The short-answer section at the end of the survey allowed students to explain what field trips they found valuable during their time at the district and how these field trips might have impacted their relationship or perception of the environment. These short-answer responses can be found in Figure 4F (refer to Appendix F). A numerical breakdown of the survey is listed below in Table 4. The results of the survey were scored using a list of codes that I assigned to each value 1 - 5; ranging from 'Weak' (1) to 'Advanced' (5) (Figure 1). The full document of survey questions can be found in Appendix H.

Score	**Value**
1 - 2	Weak
2 - 3	Moderate
3 - 4	Proficient
4 - 5	Advanced

Figure 1. Literacy Test Score Legend

Table 4. Breakdown of survey questions. Structure of survey, organized by category (i.e. Demographic, Cognitive, Behavior and Attitude) and sub-category (e.g. Critical Thinking). Number of questions in each sub-category are listed within the parentheses.

Demographic	Cognitive	Behavior	Attitude
Race (1)	Critical thinking (3)	Civic engagement & Participation (1)	Belief in individual impact (4)
Gender (1)	Identify credible sources of info (2)	Communication (4)	Motivated hope and concern (6)
Average commute time to school (1)	Knowledge and awareness (5)	Informal Education (5)	Perception of environment (3)

*note each number in the parentheses represents how many of each type of question were tested for in each sub-category

Interviews with AUSD Educators

In addition to distributing these surveys to the middle school students in the AUSD, I also conducted seven interviews with educators at LMS, BFMS and WMS. Each interview was transcribed and recorded in a separate document. In addition to this, I also took extensive notes during and after the interviews in order to extract key quotes and make this data more accessible for readers. Below is a guideline for the questions and talking points that I hoped to reach during my conversations with these educators.

Table 2. Interview Guideline for AUSD History/Social Science & Science Teachers. Template for each interview conducted.

- How long have you been teaching?
- What subject do you teach?
- What changes have you noticed in the approaches to a particular science topic during your tenure?
- Do you feel that the district is making it a priority to implement environmental literacy programming? Can you give me an example?
- In each unit, do you try to relate the topics to climate change or the environment (if it is possible/recommended)?
- What are your challenges as an educator teaching environmental topics in the classroom?
- What techniques/strategies/approaches to new curriculum have you noticed work well in the classroom?
- Are there any changes you hope to see to the district in the next few years? (e.g. regarding communication between district and other admin, development of curriculum, access to resources, etc.)

Data Analysis

To analyze the data in these surveys, I used Excel to calculate the means and standard deviations for the questions that were scored on a five-point Likert scale. The complete list of results are available in Appendix B, C and D. For short-answer questions, I planned to categorize the answers according to certain trends and themes that emerge. However, because only three students answered the short answer section, this analysis was not conducted and short answers are made available in Figure 4. of Appendix F. Because my sample size was very small, I summarized results from the surveys from the Excel data rather than performing a more detailed statistical analysis.

RESULTS

General Descriptive Findings

The survey questions were answered by one 6th grade science classroom of 25 students at Lincoln Middle School. Of the students who participated in this study, 48 % were male and 52% were female. The majority of respondents to the survey self-identified as Asian/Pacific Islander (56%) and Hispanic or Latino (28%). Other respondents self-identified as Black or African American (4%), White/Caucasian (20%), Native American or American Indian (0%), and Other (12%). Approximately 50% of students reported that they spent an average of 10 minutes commuting to school, 25% reported that they spent more than 10 minutes commuting to school and 20.8% participants spent an average of 5 minutes commuting to school. Because only one classroom of data was collected, these demographic trends are not representative of the AUSD student population at large and therefore larger no significant assumptions can be drawn from this data set. The descriptive statistics covering these demographics can be found in Table 2A. (refer to Appendix A).

Survey Responses

I evaluated each mean and standard-deviation for each five-point Likert scale question and aggregated this data to get a collective total mean for each sub-category (Table 3). Questions that did not fall on a five-point Likert scale were excluded from these calculations. The data from each category will be further discussed in the subsequent sections of this Results section.

Later in the analysis, the different sub-categories will be referred to by their abbreviations. Within the 'Cognitive' category, the sub-category of 'Critical thinking' will be abbreviated to CT, 'Identify Credible Sources of Information' will be abbreviated to IC and 'Knowledge & Awareness' will be abbreviated to KA. Within the 'Behavioral' category, the subcategory of 'Civic engagement,' 'Communication,' and 'Informal education' will be abbreviated to CE, CM and IE respectively. Within the 'Attitude' category, the sub-category of 'Belief in Individual Impact,' 'Motivated Hope and Concern,' and 'Perception of Environment and Ethics' will be abbreviated to BI, MC and PE respectively.

Table 3. Means within each category of survey responses. Breakdown of survey structure and listed means for each sub-category. Total means for each category (i.e. Cognitive, Attitude and Behavior) at the bottom of the table.

Demographic	Cognitive	Behavior	Attitude
Race (--)*	Critical Thinking (3.38)	Civic Engagement & Participation (1.91)	Belief in Individual Impact (3.85)
Gender (--)*	Identify Credible Sources of Info (2.7)	Communication (2.87)	Motivated Hope & Concern (3.82)
Average commute time to school (--)*	Knowledge & Awareness (4.24)	Informal Education (3.68)	Perception of Environment (4.1)
Totals	3.44	2.82	3.92

*These categories do not have means because they were not conducted on a five-point Likert scale

Cognitive Response

Students in this classroom scored an average of 4.24 for 'Knowledge and Awareness,' 3.78 for 'Critical Thinking,' and 2.7 for 'Identify Credible Sources of Information.' These responses indicate that students have an 'advanced' understanding and knowledge of environmental topics, a 'proficient' ability to think critically and a 'moderate' ability to identify credible sources of information. The results of the survey were interpreted using the codes in Figure 1. Table 6B (refer to Appendix B) indicates which questions on the survey correspond with which sub-category as well as the resulting mean and standard deviation. All of these survey questions in this category were drawn on a five-point Likert-scale and the resulting statistics were scored accordingly.

Behavioral Response

As shown in Table 3, the students in this classroom scored weak for 'Civic Engagement & Participation' (1.91), moderate for 'Communication' (2.87), and for proficient 'Informal Education' (3.68). The results of the survey were interpreted using the codes in Figure 1.

Table 7C (refer to Appendix C) indicates the means and standard deviations of each question and breaks up these questions by sub-category. All of these survey questions, except three multiple-selection questions and one multiple-choice question (Table 8C), were drawn on a five-point Likert-scale and the resulting statistics were scored accordingly.

Four out of the five 'Informal Education' questions were multiple-selection questions. These questions were designed to understand where the students are getting their information about the environment from and which of these sources were their favorite. While students said that they got the majority of their information about the environment from 'Television News' (77.3%), Friends/peers/relatives (68.3%) and 'Online' (45.5%), most students reported that they liked action-based activities the most; 'Outdoor Education' (68.2%) and 'Experiments' (54.5%). When asked how often they visited nearby nature areas, most students said that they visited more than two times a week (27.3%) and another large group of the students reported that they visited parks, beaches, trails, and other natural areas at least once within two weeks (36.4%).

Attitude Response

As shown in Table 3, the students in this classroom scored weak for 'Belief in Individual Impact' (1.91), moderate for 'Motivated Hope & Concern' (2.87), and for proficient 'Perception of Environment' (3.68). The results of the survey were interpreted using the codes in Figure 1. Table 12D (refer to Appendix D) matches each of the survey questions with their resulting means and standard deviations. All of these survey questions, except one multiple-choice question, were drawn on a five-point Likert-scale. The one question that was not conducted on a five-point Likert-scale was designed to assess how students self-assign value and impact their actions. From the survey results, the bulk of the students think that their behaviors impact other environments that are 5 and 25 miles away. Only 30.4% of the students in this class believed that their actions affect environments that are 100 or more miles away.

Correlative Values between Cognitive, Attitude and Behavioral Responses

Because the aim of this study is in part to understand how the students are responding to changes in the curriculum and how receptive they are to the new material, it is important that these

variables of cognitive, attitude and behavior be analyzed in reference to each other. In order to answer the objective question of how one's knowledge of the environment affects their behavior or attitude, these data points must be considered together. While many of the questions in the category were designed to test for a specific characteristic or cognitive, attitude or behavioral learning, some of the questions test for multiple characteristics simultaneously (refer to Table 14E). The total means for each of these cross-listed categories are listed below in Table 5. While these results are not statistically significant, it is most likely that the Cognitive-Attitude and Behavior-Attitude cross-listed categories have the highest correlative values because most students scored higher in the Attitude category (3.92) than the other two categories (Table 3).

Table 5. Cross-listed survey questions. Total means and standard deviations of cross-listed questions (refer to Appendix E).

Cross-listed Categories	Mean
Cognitive-Attitude	4.05
Cognitive-Behavior	3.52
Behavior-Attitude	3.97

Interview Results

After each interview was conducted, I transcribed the conversation and wrote down key quotes (refer to Table 15G). Seven interviews were conducted total. Of these seven interviews, five of the teachers taught History/Social Science and English and two taught sixth grade science. Four interviews were conducted with teachers at Lincoln Middle School (LMS), two interviews were conducted with teachers at Wood Middle School (WMS) and one interview was conducted with a teacher from Bay Farm Middle School (BFMS).

Despite that the environment was not a central topic or focus for their class, many of the teachers were still able to relate specific examples of how they integrated environmental topics and issues into their class content. For many social science and history teachers, they said that they only related environmental topics through current events. This strategy, many teachers felt, promoted and engaged student's critical learning skills and many of the teachers were able to relate specific

examples of how students brought in topics and interests from other classes and intersected them with their classrooms' assignments.

Many of the teachers said that funding for field trips was an issue. One teacher said that due to lack of care and upkeep, LMS's pond, that she uses to teach her students about the local habitat, has dried up and is no longer an ideal learning space for students.

From the interviews, it also became clear that the middle schools did not all have equal communication with the district administrative staff. While many of the teachers said that the district was making it a priority, some disagreed and said that they had not heard any information about the environmental literacy curriculum at all.

Overall, the teachers said that their students have a natural interest and motivation in these topics. In many cases, teachers reported that their students are teaching them about environmental topics and how they might relate to the content they are learning in the history and social science classrooms.

DISCUSSION

Although there are infinite combinations of behavior, attitude, and knowledge that could characterize an environmentally literate person, this study aims to understand if these characteristics are teachable. Of course, there are many costs and barriers to entry associated with environmentally literate behavior; for example, not everyone can afford to buy eco-friendly, sustainable items or to take the time off of work to participate in an environmental rally or organization. While it is important to acknowledge these barriers, this study will not investigate these socioeconomic challenges extensively and will instead focus on the characteristics of environmentally literate individuals and educator's challenges with teaching this new programming.

There are many strategies that are used to tackle climate inaction, climate denialism and climate apathy; ranging everywhere from environmental campaigning to art galleries. Climate change awareness and action is a multi-part issue and therefore cannot be solved by one group or strategy alone. Therefore, to mitigate this vast scale, I have chosen to focus the scope of this study on how environmental literacy education can be used as a method for promoting environmental consciousness, behaviors and actions from an early age. Building an environmentally literate

culture, one that is able to think critically and takes motivated action towards a more sustainable future, is a prerequisite to having other environmental initiatives since this work cannot be effective if the public is unreceptive, skeptical, denialist, or pessimistic about the future. For these reasons and many others that I have outlined extensively in this paper, I am seeking to qualify best educational strategies for teaching students to care about the environment and apply their classroom knowledge to their lived experiences.

Because other studies and research have noted that ethics, morals and attitudes towards the environment also play greatly into one's responsiveness and receptiveness of environmental information, I have made 'attitude' a third variable in my set of survey questions. Because the COVID-19 crisis severely limited the survey data that I was able to collect, since classrooms transitioned to online operations during the time of my data collection, I will rely on the interview data to draw my main conclusions.

Environmental Literacy in the AUSD

a). Teachers

Because 5 out of the 7 teachers interviewed for this study were history/social science and English teachers, a majority of the environmental content that they taught was based around current events and activism. While environmental topics were not central learning goals for many of these humanities teachers, many of them still reported that integrating environmental topics in their class content helped engage their students' critical thinking skills. Some teachers reported that field trips enforced students' learning about the environmental topics that they learned in the classroom.

The two science teachers that were interviewed reported to have regularly emphasized environmental topics and issues in their classroom. For example, these teachers would have their students do a coastal clean-up and report their data to NOAA. They have also extended many volunteer opportunities with the Greater Farallones National Marine Sanctuary to their students; giving the students a chance to practice their public speaking and scientific communication skills.

When asked about the challenges that the teachers faced in the classroom regarding this content, teachers reported both institutional challenges at the school site and content issues with the curriculum. In regards to institutional challenges, many of the teachers said that funding for

field trips and transportation was an issue. One teacher said that educational spaces on campus like ponds required funding and maintenance that the district could not financially support. Regarding environmental content, one sixth grade science teacher reported that students had the most challenges understanding the connection between CO2 and global warming. Two other teachers said that their students had a hard time thinking globally and understanding what they can do to mitigate global climate change.

Of the interviews that were conducted, 5 of the 7 teachers said that they felt that the district was making it a priority to promote environmental literacy education in the district. The two that said it was not a priority either said they had not heard any information from the district at all about this programming and that no resources had been made available to them to teach environmental content in a non-science classroom. Because these two reports came from teachers at different schools, I think that the district's communications with teachers may not be thorough at any one particular school site. Some of the teachers said that while the district was making environmental literacy education a priority, they were not following through with some of their mission goals. One teacher, for example, recommended that LMS should switch to LED lighting, aim to supply the teachers with an electric fleet of cars, and implement other green initiatives on campus.

It should be noted that the teachers who responded to my interview request were likely some of the most environmentally active and involved educators in their cohort. Despite this assumption, two of the teachers that I interviewed said that they had not heard of any environmental literacy initiatives in the district and one of these teachers said they had no resources to teach environmental topics in their history class. Although these reports contradicted those of the other teachers, it is still very important to track these reports since they identify areas for improvement in the district.

b). Students

Because of the COVID-19 crisis, I was only able to survey one classroom via paper surveys before the shelter-in-place orders took place. Because I was only able to collect a small sample, this data is not representative of the district's efforts as a whole. However, we can look at the trends of data within this single sixth grade classroom.

The survey results here indicated that while students had an advanced (4.24) knowledge and awareness of environmental topics, they reported to have a proficient (3.38) ability to think critically. Though these students scored well in both areas, a lot of research suggests that critical thinking is foundational for all other environmental literacy behaviors and characteristics. Teachers can improve upon these areas by having the students relate topics about the environment to other classes or disciplines, having students explain the importance and relevance of certain environmental issues, and identifying credible sources of information as a classroom.

In the category of attitude, students demonstrated proficiency in 'Belief in Individual Impact' (3.85) and 'Motivated Hope and Concern' (3.82) and an advanced ability in 'Perception of Environment and Ethics' (4.1). Again, this data set is not large enough to demonstrate any statistical significance, however, this data might suggest that students have a natural interest and personal connection to the environment but don't necessarily know what they can do to help the environment. This disconnection was a concern of many of the teachers that I spoke to, which is why many of them responded by making lists of environmental actions that the students can feasibly do.

In the category of behavior, the majority of students reported that they got their information about climate change from 'Television news' (77.3%), 'Friends/peers/relatives' (68.2%) and 'Movies/documentaries' (40.9%). I think this is interesting because television and film often perpetuate the misconception that climate change is a distant phenomenon (Cronon 1995). And not surprisingly, the majority of the students in this class (69.9%) said that they believe their actions and behavior only affect environments that are between 5 and 25 miles away from them. While we cannot draw any sure conclusions from this, it is still interesting to consider and is a question that future research may want to investigate.

Content

Although many studies define environmental literacy according to specific metrics and categories, I defined and assessed environmental literacy according to their a). cognitive knowledge of the subject, b). participation and engagement in environmental behaviors and c). attitude and perception of the environment. This study not only aims to understand how these three components make up the traits of environmental literate individuals, but also to understand the

relationship between these variables; seeking to understand the directionality and correlation between these three components.

a). Knowledge v. Behavior

One of the most central relationships in this study was the correlation between environmental knowledge and behavior. This tension between knowledge and behavior is a site of interest for many environmental literacy education groups, including the AUSD who advertise field trips and volunteering as goals for their new curriculum on the district website. It is important to understand the relationship between knowledge and behavior so that educational groups can identify which teaching strategies are most impactful and inspire the students to make changes to their everyday behavior and action. This should be an essential aim of environmental literacy education since one's environmental behavior can have direct impacts on the physical health of the environment. By understanding whether or not environmental knowledge impacts behavior, we can assess how useful our environmental education techniques are. Tuning this idea more, we can also assess what specific topics or ideas are the most essential for students to adopt other environmental literate qualities. A few teachers said that many of their students had a hard time understanding global environmental issues related to them. Because many teachers found this connection between the global and the local was challenging for students, many said they showed pictures of young environmental activists who the students could relate to, like Greta Thunberg, or gave their students actionable items that could do to reduce their environmental impact.

b). Attitude v. Behavior

The other relationship that I was very interested in was the correlation between environmentally literate attitude and behavior. It is important here to explain that while correlation might identify the magnitude of relatedness between attitude and behavior, it does not identify direction. In other words, are environmentally literate attitudes necessary for environmentally literate behavior? Or is it instead the inverse, does taking environmental action, and practicing environmentally friendly habits enable one's ability to care for the environment?

c). Knowledge v. Attitude

Another relationship that was investigated in this study was that of knowledge and attitude. Identifying a correlation between these two components would answer the question of whether knowledge about the environment is necessary for someone to care about it or if someone's innate concern about the health of the environment makes them more inclined to do their own investigation and research into environmental topics.

One sixth grade science teacher at LMS also explained that students learned to trust science more by working through real data sets, saying:

> *"I was a NOAA teacher at SEED, I developed lessons in that experience and I brought data from NOAA back into the classroom. I'd say it's challenging for them to make sense out of it because data can be so dense. But part of this lesson includes them reading my blog about what it's like to be a crew member and live on a ship while collecting data...It makes you really appreciate how big the ocean is and how important it is and I think that that's kind of hard to grasp sometimes. It's challenging for them and it's valuable to have that real life experience of working with data.*"

Here, the teacher indicated that using real data enhanced the student's ability to work through real science problems and that relating her own personal experience as a scientist helped her students understand what it means to live and work as a scientist. Many other studies have advocated for this model of education since this direct interaction with data leads the students to engage their critical thinking skills and be less skeptical of scientific data itself (Cooper 2011). This study also suggested that having a professional scientist teach science subjects is often the best way to teach these topics because it makes scientists themselves more accessible to the public and therefore more trustworthy (Cooper 2011). This is very important because some studies have shown that science education can increase scientific skepticism if educators do not teach their students how to identify and interact with real, credible data (Cooper 2011). As many other political studies have shown, trust is necessary for the audience to listen to the speaker or teacher (Cooper 2011, Lewenstein 2002). According to this research, this teacher is modeling a science education that builds trust, teaches students to care about the environment and see science as something that is relatable and accessible to them.

d). Knowledge, Attitude & Behavior

Although it is difficult to say for certain that these three components have impacts and effects on each other given this small data set, it is still worthwhile to speculate what trends a larger data set might have revealed. Analyzing these three components together could answer questions like:

- Do environmental attitudes precede environmental behavior or can alterations to one's actions and routines change their attitude towards the environment they live in?
- What information about climate change will make the public care and want to take preventive measures against global climate devastation?

From this data set, there are no conclusive answers to these questions. However, in a way, the interviews with the teachers did answer these questions by speaking to teaching strategies that worked best for their classrooms. For many teachers that I spoke to, they reported that students cared more about environmental topics that they felt directly related to them. Bearing this in mind, many teachers said that they used current events as a way to relate the information to their students or used specific examples of how a student's actions related to a larger global concern. One teacher said this almost directly, explaining:

> "*What I find to be very successful is when I can relate it back to an issue that they see every day. An example of this would be when we were talking about the deforestation of Borneo, and the primary reason behind being palm oil plantations. We took a look at what palm oil used for, and I gave them a list of all the different candy bars that contain palm oil.*"

One teacher at BFMS reported that campus wide initiatives and competitions, such as the "Walk and Roll" week in which every classroom commits to reducing their mileage for one week by walking or biking to school. Not only does this competition reduce students' carbon footprints but it also gets them excited and thinking about their environmental impact everyday. In this way, we can see how practicing a certain action or behavior, such as switching to alternative methods of transportation, can inspire one to care more about the environment. It should be noted here that behavior should not be taken as the sole indicator for climate literate behavior because some

sustainable options are not feasible for certain groups of people. For example, some students who live an hour or more away from school do not have the option to walk or bike to school; this option is only afforded to those who have the means and ability to switch to another alternative.

Many of the teachers also reported that they used natural spaces as a learning tool. For example, BFMS has a garden where K - 5 classrooms learn how to garden, compost, mulch, harvest and use the food they grow to make meals. At LMS, one science teacher reported that they used the campus's pond as a way of teaching their students about the endemic wildlife to California's coastal habitats. All of the teachers that reported using natural spaces as learning centers also said that their students had a great time going outdoors and always looked forward to learning outside. One sixth grade science teacher spoke to this very well, saying, "*They love going outside to do the projects, when they get to shovels and tools and they like just being outdoors or whenever they get to go to an area. They just love it. It's a really wonderful place.*" Though few in number, these reports speak to how behavior and action, such as working outside in a garden or birdwatching, can make a student care more about the environment; thus demonstrating the bridge between behavior and attitude that was intended to be addressed by the survey.

Synthesis

Although there is an abundance of environmental advocacy and political action responding to climate change, there is still a large public debate about the existence of climate change itself. While many philosophers have debated about the ontological roots of this skepticism and denialism, few have rooted this discussion in the contemporary discussion of climate change. Fewer still have related this issue to the lack of environmental literacy education in the public school system. This lack of breeding between theory and application is unfortunate because many studies have shown that informal and formal science education lacks an understanding in the audience it is addressing (Cooper 2011). This underlines many important questions that this study aims to address such as, how can we expect to shift our societal and cultural attitude towards climate change if a significant portion of the population is not willing to hear this information at all? Furthermore, how can we expect the public to make informed decisions and identify credible sources of information if they are not formally educated how to do so?

Putting this theory in conversation with educational spaces like the AUSD, the aim of this study becomes an aim to understand how to make scientific fact and information accessible, interesting or relevant to a particular audience and what teaching strategies and techniques we should invest in in order to motivate future generations to take action against climate change.

Limitations & Future Directions

Like many other psychological and social studies, this study is limited to the socio-political context and demographic of Alameda Unified School District region. The results of this study could have been highly influenced by other variables such as family structure or household income but these were not considered in this survey for the sake of maintaining student anonymity and respecting their privacy to this information. With any human subject study, there are many regional, cultural and social values that may have influence over the questions but are not necessarily accounted for in the resulting data. It is important to note the influence of these, however, since 'pro-environmental' behavior is often associated with individuals of an elevated social standing or economic class. Future studies may want to conduct a more detailed demographic analysis to account for these confounding variables. Additionally, future research might benefit from an increased sample size since the time and limitations this project only allowed for few teachers to be interviewed and only a few classrooms to be surveyed.

Due to the COVID-19 crisis and the shelter-in-place orders, it was very challenging to collect the data that I intended to because my communications with the district and teachers had been stalled during the time of the global health crisis. During this time, it was very difficult to schedule interviews with teachers and to collect surveys from students since many of them longer had access to a computer. Due to the resulting chaotic transition to online operations, it was unfeasible to expect teachers to hand out an online survey to their students. For this reason, I was only able to collect one classroom of data via paper surveys that I distributed before the shelter-in-place orders were announced. So while I had intended to survey the entire district, I was only able to collect surveys from middle school classrooms during this time due to my time constraints.

Due to my small sample size, it is not possible to draw significant conclusions about the district's environmental literacy efforts. Despite that I was not able to collect a robust set of data as I had hoped, I did find that the interviews revealed a lot of information about the district's work

and hopefully these results can be useful for teachers in the district or the AUSD administrative staff.

In addition to these data limitations, I also had to cut a lot of the questions from my survey. My mentor and Terri Elkin, the Secondary Education Coordinator of the district, recommended that I shorten the survey since many of the students have a short attention span and will not fill out a long questionnaire. Despite that my survey was a single, double-sided page, many of the students still did not completely fill out the questions on the back. This indicates that the students either did not have enough time to finish the survey in class, they only chose the questions they thought they could answer or they did not want to finish it. Whichever the case, this confirms both my mentor's and Terri's expectations. While it would have greatly benefitted my study to have a longer questionnaire of several categories and questions, I had to cut many of these questions for these reasons.

Future research could also look at long-term effects of environmental literacy education, following this specific cohort of AUSD alumni and investigating how their environmental behaviors and attitudes as adults may have changed as a result of their primary education. And if a future student in this department were to carry this project forward, this data set could be expanded to get a more accurate representation of the district. Future studies could also conduct a comparative case study with other district's environmental literacy efforts.

The most compromising variables in this study are perhaps that every educator's teaching method, style and personality will change the affect the ways that the students receive the material. While it is outside of the scope of objective measurements, it is still important to recognize that the way a teacher connects with the students, whether that be through humor, intensity or other characteristics, will have a great effect on the ways that the students perceive the material. The interview portion of my data results is designed to help gage how teachers interact with their students, however this is not a perfect measurement. To avoid any confusion with variation in teaching style, future studies may want to keep this variable constant throughout the studying period.

It would be remiss to not acknowledge the many socio-economic issues that affect a student's access to certain resources or opportunities. In many cases, some communities may not have equal access to volunteer opportunities, civic leadership development programs, youth centers and other facilities that offer opportunities for students to apply their environmental

knowledge to their local communities (Educational Equity 2016). Some might argue here that the advent of technology allows for online climate communities to form, however, this argument assumes that all families have a home computer, which is again an issue of financial equity. While this study does not investigate these socioeconomic limitations extensively, future studies should consider the social and demographic context of their population.

Broader Implications

As climate change continues to present devastating effects on global populations and foreshadows a less habitable and sustainable future, the time window to have debates about the existence of climate change is shrinking. Global bodies, institutions and groups of scientists have agreed that climate change is a global threat and demands global participation and engagement. For these reasons and countless others, there is a growing global demand for environmentally consciousness and environmentally responsible behaviors, practices and technologies. While there are many groups and organizations that have political sway and the financial ability to direct the public towards a more anti-science culture, such as media and religion, the federal government does have the power and control to invest in public education as a means of disarming climate skeptic and climate denialist tactics. For this reason, it is pertinent that we view the education system as a central institution for changing public attitude towards the debate around climate change. And as other environmental literacy groups like Ten Strands and MARE have shown, environmental literacy not only teaches students how to think about the environment responsibly, but also arms them with the critical thinking skills that they need for highly achieving in Common Core standards, such as math and English standards. Therefore, it should be noted that environmental literacy education not only promises to build a more environmentally conscious and activated community, but also a community that is able to think between disciplines; thus increasing encouraging students to take novel approaches to old problems and challenges. This paradigmatic shift in public education would promote innovative thinking that will be paramount in a rapidly evolving and technologically advancing future.

This study aims to not only reveal what might be the best techniques and strategies for environmental literacy groups but also to provide a model for how other educational groups can more effectively connect with their intended audience. At the heart of this study is an attempt to

understand how knowledge informs action and behavior. This is the aim of many other fields of study, from political campaigns to social advocacy groups. To define what information and knowledge is essential to become a motivated, engaged and empowered individual is a question that many organizations may ask themselves about their own members and audiences. Therefore, the work in this study can be used to understand more broadly how we can make our education systems and other public work systems more effective and strategic.

Conclusion

While this project began as a case study of the environmental literacy curriculum taught at middle schools in the Alameda Unified School District, at the heart of this project lies the central question of 'what is "environmental" behavior and how do we teach this?' This is a very challenging question because the term 'environmentally literate behavior' means something different to every educator that I spoke to in this district.

There are many ways to embody and regularly practice environmentally literate behavior. For many, literacy may look like discrete knowledge and understanding the core issues of climate change, while others may embody a lived knowledge; one that is expressed through how someone interacts with, advocates or perceives the environment. As I found in my study, I found that critical thinking was very important for literacy. Critical thinking, as many teachers also explained to me, is not simply the ability to regurgitate information that one learns in a classroom, but to be able to synthesize, explain and understand how that information influences or is influenced by other factors. This definition of literacy requires a much deeper assessment of learning which is why this classroom survey did not ask conceptual questions about climate change, but instead sought to identify patterns of critical thinking and inquiry.

While there may not be clear answers to the questions that I have posed with this project, this case study does begin a dialogue between broader theories of climate science denialism and the public education system. It is important to draw this connection between epistemological theories of environmental knowledge and climate change education because the public school system has the unique opportunity to captivate young audiences and teach them how to make informed decisions and adopt environmentally literate habits that they will practice for the rest of their lives. Furthermore, as I have explained with other studies and research, science education

programs can engender skepticism if necessary precautions are not taken. Therefore, it is important to engage these broader theories of education in order to understand how we can teach environmental topics most responsibly and most equitably.

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APPENDIX A. Classroom Demographics

Table 2A. Descriptive statistics of the demographics of the student population. Data collected from 25 students in a sixth grade science classroom.

Variables	**Responses**	**Percent (%)**
Grade Level		
6th	25	100
7th	0	0
8th	0	0
Gender		
Female	13	52
Male	12	48
Non-binary	0	0
Trans	0	0
Other	0	0
Prefer not to answer	0	0
Race/Ethnicity		

White/Caucasian	5	20
Hispanic or Latino	7	28
Black or African-American	1	4
Native American or American Indian	0	0
Asian/Pacific Islander	14	56
Other	3	12
Prefer not to answer	1	4
Average commute time to school		
>1 hour	0	0
1 hour	1	4.2
45 min	0	0
30 min	0	0
20 min	5	20.8
10 min	12	50
<10 min	6	25

APPENDIX B. Cognitive Response

Table 6B. Survey questions for Cognitive sub-category responses. List of questions from the 'Cognitive' portion of the survey and organized by sub-category (i.e. Knowledge & Awareness (KA), Critical Thinking (CT) and Identify Credible Information (IC)).

Cognitive sub-category	Survey Question	Mean	Standard Deviation
KA	I am aware of environmental issues affecting my local community and could confidently discuss them with a friend, peer or relative.**	3.88	1.24
KA	I think that human lives and well-being depend on earth's natural resources (e.g. soil, fresh water).	4.35	0.71
KA	I think that an environmental issue in one environment can affect the health of another environment (e.g. car pollution affects ocean health).	4.5	0.78
KA	(this question does not fall on a Likert scale, listed in Table 4.)	----	----
CT	When I learn about a certain environmental topic in class, I think about the ways in which it relates to my personal life.	3.36	1.29
CT	If I don't understand a topic the first time I hear it in class, I talk through my confusion with a peer, friend, teacher or relative.**	3.27	1.20
CT	When I visit a nature site, museum, aquarium, etc. I find myself remembering things I learned in class and thinking about the ways that my knowledge in class relates to the things I observe.	3.5	1.30
IC	I investigate a source's credibility or reputation if a particular article, episode, etc. uses strong language and doesn't have professional citations.**	2.48	1.08
IC	After hearing about something in the news from a peer, friend or relative, I do my own research online to investigate the topic more.**	2.91	1.23

**These questions also appear in Appendix E. Cross-Listed Responses

APPENDIX C. Behavioral Response

Table 7C. Survey questions of each Behavioral sub-category response. List of questions from the 'Behavior' portion of the survey and organized by sub-category (i.e. Civic Engagement & Participation (CE), Communication (CM) and Informal Education (IE)).

Behavioral sub-category	Survey Question	Mean	Standard deviation
CE	Do you volunteer or participate in environmental clubs/societies/activities?	1.91	1.11
CM	How often do you talk about climate change or environmental topics in your science classes?	3.84	0.85
CM	How often do you talk about environmental issues that you might learn about in class with a friend, peer or family member?	2.92	1.19
CM	How often do you talk about climate change or environmental topics in your social science/history classes?	2.92	1.29
CM	How often do you talk about climate change or environmental topics in any extracurriculars/clubs/organizations you are a part of?	1.8	0.96
IE	I feel excited to learn more about the environment after my class goes on field-trips to local nature sites.**	3.68	1.25

**These questions also appear in Appendix E. Cross-Listed Responses

Table 8C. Short answer and multiple-selection questions for behavioral sub-category.
List of questions from 'Behavior' portion of the survey that did not fall on a five-point Likert scale.

Behavioral sub-category	Survey Question	Responses	Percentage
IE	What is the most memorable outdoor experience/field trip that you remember during your middle school education? If you have not gone on a field trip, write "None." (short answer) (Refer to Figure 4.)	3	NA
IE	How do you learn about the environment outside of school? (check all that apply) Television News Online Friends/relatives/peers	 17 10 15 5	 77.3 45.5 68.3 22.7

	Books Magazines Radio Movies/documentaries National Parks Museums/conservation centers	0 5 9 4 2 5 1	0 22.7 40.9 18.2 9.1 22.7 4.5
IE	What is your favorite way to learn about the environment or climate change? (check all that apply) Outdoor education/field trips Movies/documentaries Museums/conservation centers Online Class Visit national parks/nature reserves Experiments Other	 15 8 7 3 2 8 2 12 0	 68.2 36.4 31.8 13.6 9.1 36.4 9.1 54.5 0
IE	On average, how often do you visit nearby natural spaces (e.g. parks/beaches/forests/trails/lakes)? More than once a week Once a week Once every two weeks Once a month A few times a year Once a year Never	 6 4 4 3 4 0 1	 27.3 18.2 18.2 13.6 18.2 0 1

APPENDIX D. Attitude Response

Table 12D. Survey questions of each Attitude sub-category. List of questions from the 'Attitude' portion of the survey and organized by sub-category (i.e. Belief in Individual Impact (BI), Motivated Hope & Concern (MC) and Perception of Environment (PE)).

Attitude sub-category	Survey Question	Mean	Standard deviation
BI	I believe that changing my personal habits and lifestyle can impact the health of the environment.**	4	0.88
BI	I always recycle and avoid throwing things away in the landfill when possible because I think that it is important.**	4.25	0.85
BI	I think that it is important to talk about environmental issues with other people so that we can learn together.**	3.96	1.07
BI	I think that my behaviors and actions can inspire other individuals to make changes to their own habits and lifestyle.	3.22	1.13
MC	Do you feel that you have already been affected by climate change?	2.79	0.93
MC	I care about global environmental issues caused by climate change (e.g. sea level rise, drought, extreme weather)	4.64	0.86
MC	I care about environmental problems in my local community (e.g. ocean pollution, air pollution, urbanization).	4.58	0.78
MC	I believe that advances in technology can help decrease the effects of climate change.	3.33	0.82
MC	I believe that government policy can help decrease the effects of climate change over time.	3.52	0.99
MC	I am concerned about climate change and I believe that there are achievable solutions to help us avoid effects of climate change.	4.08	0.93
PE	I am upset if I see someone litter or leave their trash behind.**	4.04	0.81
PE	Is it important to you that you have parks near your home?	3.86	1.25
PE	Is it important to you that your nearby city streets, parks and beaches stay clean?	4.33	0.86

**These questions also appear in Appendix E. Cross-Listed Responses

Table 13D. Responses for multiple-choice attitude response questions. Multiple-choice questions that did not fall on a five-point Likert scale.

Attitude sub-category	Survey Question	Responses	Percentage
BI	My actions/behavior/habits impact the environment…**		
	5 mi away	8	34.8
	25 mi away	8	34.8
	100 mi away	0	0
	1000 mi away	2	8.7
	+100,000 mi away	5	21.7

**These questions also appear in Appendix E. Cross-Listed Responses

APPENDIX E. Cross-listed Responses

Table 14E. Cross-listed survey questions. Some survey questions were based off of the Environmental Literacy Research Study conducted in Taiwan (Shih-Wu et al. 2018). All of the questions within this category apply to more than one category (e.g. Behavior, Attitude, Cognitive).

Cross-listed Categories	Survey Question	Mean	Standard deviation
Cognitive-Attitude (Cross-listed between KA and PE)	I am upset if I see someone litter or leave their trash behind.	4.04	0.81
Cognitive-Attitude (Cross-listed between KA and PE)	Learning about environmental topics in class makes me care more about the health of my local community and environment. (If you do not learn about environmental topics in class, do not respond to this question)	4.05	0.84
Cognitive-Behavior (Cross-listed between CT and CM)	If I don't understand a topic the first time I hear it in class, I talk through my confusion with a peer, friend, teacher or relative.	3.27	1.20
Cognitive-Behavior (Cross-listed between CT and CM)	I am aware of environmental issues affecting my local community and could confidently discuss them with a friend, peer or relative.	3.88	1.24
Cognitive-Behavior (Cross-listed between IE and CM)	After hearing about something in the news from a peer, friend or relative, I do my own research online to investigate the topic more.	2.91	1.23
Cognitive-Behavior (Cross-listed between KA and CE)	Learning about environmental topics in class makes me want to take action and make a positive impact on my local community and environment. (If you do not learn about environmental topics in class, do not respond to this question)	4	0.93
Behavior-Attitude (Cross-listed between IE and PE)	I feel excited to learn more about the environment after my class goes on field-trips to local nature sites.	3.68	1.25
Behavior-Attitude (Cross-listed between BI and PE)	I believe that changing my personal habits and lifestyle can impact the health of the environment.	4	0.88

Behavior-Attitude (Cross-listed between CM and MC)	I think that it is important to talk about environmental issues with other people so that we can learn together.	3.96	1.07
Behavior-Attitude (Cross-listed between CE and BI)	I always recycle and avoid throwing things away in the landfill when possible because I think that it is important.	4.25	0.85
Behavior-Attitude (Cross-listed between PE and BI)	My actions/behavior/habits impact the environment…*	Responses	Percentage
	5 mi away	8	34.8
	25 mi away	8	34.8
	100 mi away	0	0
	1000 mi away	2	8.7
	+100,000 mi away	5	21.7

*This question was not included for the total mean of this cross-listed category

APPENDIX F. Behavioral Graphs

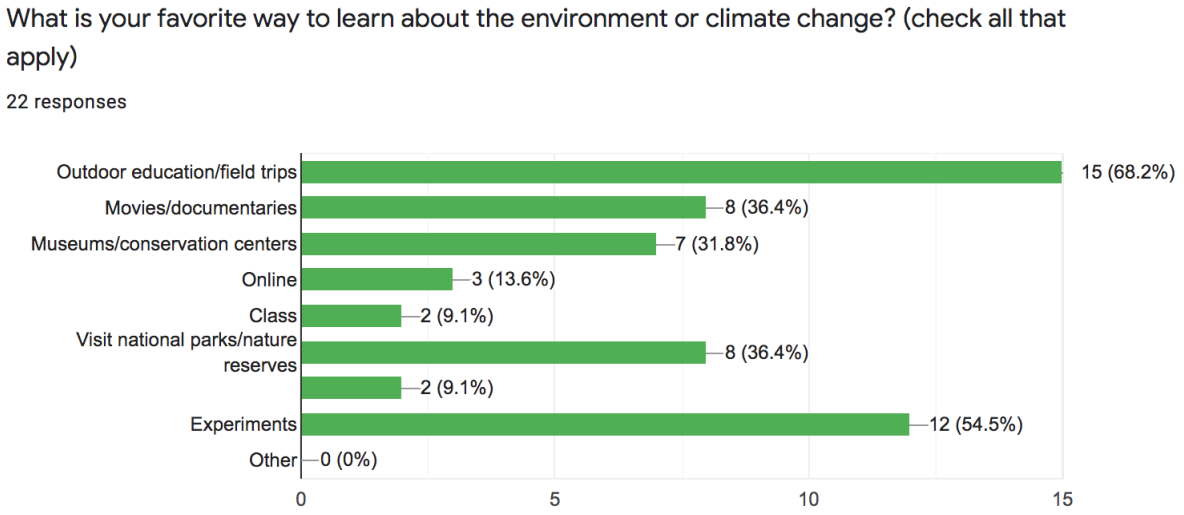

Figure 2F. Informal Education (IE) multiple option question responses. Student responses to 'their favorite ways of learning about the environment.' Twenty-two students in this classroom responded to this question. Because students could choose more than one answer, each line represents the percentage of responses out of the 57 total answers that were chosen.

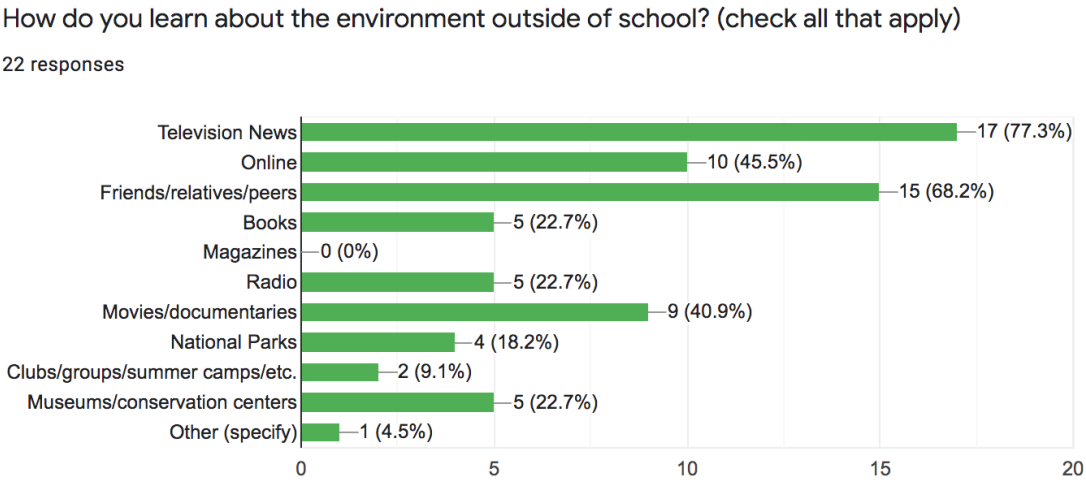

Figure 3F. Informal Education (IE) multiple option question responses. Student responses to 'ways they learn about the environment.' Twenty-two students in this classroom responded to this question. Because students could choose more than one answer, each line represents the percentage of responses out of the 73 total answers that were chosen.

What is the most memorable outdoor experience/field trip that you remember during your middle school education? If you have not gone on a field trip, write "None." (short answer)

23 responses

None
New Years Parade in San Francisco. Not an actual field trip but orchestra activity after school days (on weekend)
The most memorable time was me going hiking to a hill with nature every where.

Figure 4F. Informal Education (IE) Short-answer Responses. List of student responses to the open ended question at the end of the survey.

On average, how often do you visit nearby natural spaces (ex: parks/beaches/forests/trails/lakes)?

22 responses

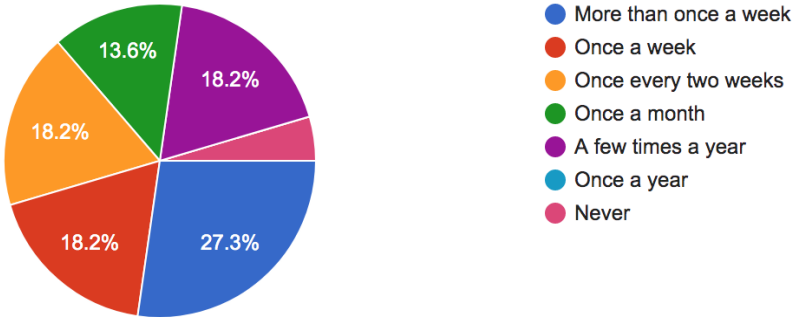

Figure 5F. Informal Education (IE) Multiple-Choice Responses. Twenty-two students responded to this survey question. Graph shows what percentage of students in this classroom visit natural spaces often based on a scale of 'More than once a week' to 'Never.'

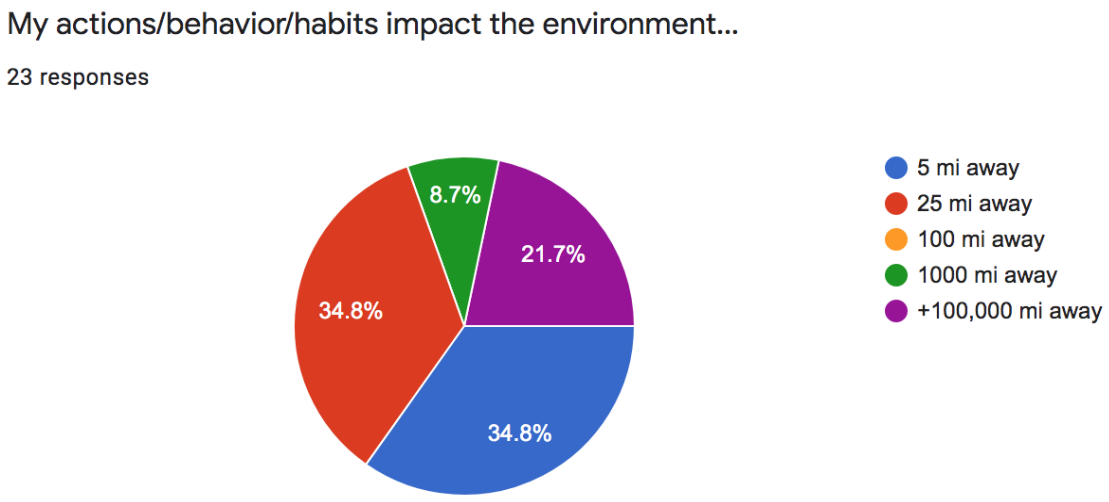

Figure 6F. Perception of Environment (PE) Multiple-Choice Responses. Twenty-two students responded to this survey question. Graph shows how far students expect their 'actions/behaviors/habits' to impact the environment, based on a scale of '5 miles away' to '+100,000 miles away.'

APPENDIX G. Interview Quotes

Table 15. Key quotes from Educator Interviews. Quotes were selected according to common themes and trends. Representative quotes of these themes are listed below.

Interviews Quotes from AUSD Teachers
What changes have you noticed in the approaches to a particular science topic during your tenure? "So the district has made a big change with the Next Generation Science Standards coming in, and those standards include a human impact component. And then now we have the EP&Cs also in the system, and the district has been very helpful in supporting that work, which has been wonderful and exciting. They've also been supportive in sending us to conferences about environment literacy and climate change conferences. Our secondary coordinator, curriculum coordinator has been really supportive of teaching climate change, and that there's been a change in that. We see that in society where people are more aware and more interested in these classes as well. I think that's challenging to teach." **Do you feel that the district is making it a priority to implement environmental literacy programming? Can you give me an example?** "Yeah, I think so, for example, I just had a student last week who was asking for her notes. We were watching the movie "Chasing Coral" and talking about bleaching corals, and she said, 'Can I take these notes with me? Because I'm thinking about doing a project in my CORE class on that and I'd like to use this for my presentation.' So I think it definitely starts getting some ideas going in their heads and they build on that and apply it to other areas with critical thinking." **In each unit, do you try to relate the topics to climate change or the environment (if it is possible/recommended)?** "[Climate change] is always relevant for us because in terms of both English and History, there's a continual study of current events and so the environment is always in our news magazines or in the news that we watch. So it's definitely always on the forefront of our minds." **Have you taken your classroom on an environment related field trip, program, workshop, or experiential learning experience? If so, do you think this experience has promoted critical thinking?** **"**The outdoor experiences that we have at our school are located on the San Leandro estuaries and so we do a project that is long. We're right on the water so we go outside, and we work in our nature area. We have a quarter acre nature area that's right on the water, and then along the shoreline as well and the

focus of the project has been on removing non-native invasive plants, planting native plants and cleaning up with marine debris."

"So the cleaning up of litter feeds into the coastal clean-up and we report our data to the Coastal Conservancy and then our whole project is funded by NOAA, since we're a NOAA ocean guardian school. And we report our data to NOAA. So they're very excited to do all that. I ask for volunteers, generally to do the extra presentations and there's always a handful of kids who were really interested"

"They love going outside to do the projects, when they get to shovels and tools and they like just being outdoors or whenever they get to go to an area. They just love it. It's a really wonderful place."

What are your challenges as an educator teaching environmental topics in the classroom?
"Because they are adolescents, they're so already self-consumed with just their own little world, it's really hard for them to think outside of Alameda. What I find to be very successful is to relate an issue to what they see every day."

"I would say where we all kind of fall short is with solutions because I'm not a science teacher, so as much as I want to empower them to learn and investigate and innovate, I don't feel like I have the capacity to I don't get that much further than that, it's for me more of just introducing them to their own power. And they're literally 12. So hopefully they learn things but I don't feel like there are barriers to them understanding it."

If you are teaching environmental topics in your classroom, what topics or material do you notice your students have the most challenges with?

"There are some kids who really don't understand that link between carbon dioxide and climate change. So that's probably a content area, it's that topic that's challenging to teach but I think the district has a lot of support for it. And a lot of kids are really interested, and I think that's probably one of most important things we can teach these days, to get them to get their bright minds wrapped around it and start liking it to solutions."

What techniques/strategies/approaches to new curriculum have you noticed work well in the classroom?

"I was a NOAA researcher and I developed lessons in that experience. I brought back that data to the classroom. I'd say that's challenging for them to make sense out of because data can be so dense. It's

thick, it's dense and I think it's challenging for them, but part of the lesson there is for them to engage with data and see about what it all means and why it's important. Part of that lesson also includes them reading my blog of being a member of the crew helping to gather data and learning about what it's like to live on a ship and learning about what kind of data you collect. So, content-wise, there that extends what we do here in class because it links it to the ocean, like the real big ocean that's right out there."

Are there any changes you hope to see to the district in the next few years? (e.g. regarding communication between district and other admin, development of curriculum, access to resources, etc.)

"Well, I don't think it's so much the district, it's just a lack of curriculum development for social studies textbooks. Maybe for 8th grade but overall for 6th and 7th grade there's no place in the textbooks where you could incorporate that kind of curriculum. There are not a lot activities going on in the state or that I think in the nation. Nothing that has been brought in front of us, but maybe I'm ignorant. But it's not like I haven't been looking, we've been looking for new textbooks that would incorporate some of these ideas and a social justice stance. There's just not a lot of material being produced."

"So that's my biggest concern in terms of environmental awareness or literacy or education is not just the purely scientific and theoretical and not even just the list of things you can do, but then the actual oversight and practice when we want those things to happen. Because sometimes where I see things falling short it's just very frustrating."

What resources and support would you like the district to provide you with so that you can best teach environmental literacy?

"Personally I find that when school districts are as hands-off as possible, we as teachers actually get the most done, simply because they're thinking more on a budgetary restraint and are thinking about state laws they have to abide by, and so they tend to put stuff out there in ways that aren't necessarily teacher and/or student friendly. So the only thing I would like to see from the Alameda or from any school district would be for them to say 'Hey we would love for you to teach something on environmental literacy, here is web link full of amazing resources and we're not going to check in on you, we just want you to do this.' And I personally find that when there's less of pressure it makes it easier for me to do things."

Off-script comments by teachers:

> “A lot of kids are really interested, and I think that's probably one of most important things we can teach these days, to get them to get their bright minds wrapped around it and start linking it to solutions.”
>
> “Often my students are educating me or they're educating the rest of the class. For example, before we went to lock down we had written speeches for this speech contest in our community, it's called the "Season of Non-violence” and they're so take a cue from Dr. Martin Luther King or other activists who are non-violent and write a speech about beloved community, and we can promote the idea of the beloved community, in Alameda, which is reteach and many students, probably 50% do their speeches about environmental activism, and environmental concerns.”

APPENDIX H. Survey Questions

Environmental Literacy Survey

Layla Chamberlin is a researcher at UC Berkeley studying the development and implementation of environmental literacy education in the Alameda Unified School District.

The survey is estimated to take about 10 minutes to complete. We would greatly appreciate your participation in this study as the resulting information will help the district understand how students are responding to this curriculum and what challenges we can expect. If you have any questions, concerns or additional comments, please feel free to contact Layla at lchamberlin16@berkeley.edu.

Please do your best to answer these questions as honestly and authentically as you can.

1. Grade Level
6th
7th
8th

2. Gender
Female
Male
Non-binary
Trans
Other
Prefer not to answer

3. Race & Ethnicity (Check all that apply)
White
Hispanic or Latino
Black or African American
Native American or American Indian
Asian / Pacific Islander
Other
Prefer not to answer

4. Average commute time to school
> 1 hour
1 hour
45 min
30 min
20 min
10 min
<10 min

5. Do you feel that you have already been affected by climate change?
Strongly disagree 1 2 3 4 5 Strongly agree

6. I care about global environmental issues caused by climate change (e.g. sea level rise, drought, extreme weather)
Strongly disagree 1 2 3 4 5 Strongly agree

7. I care about environmental problems in my local community (e.g. ocean pollution, air pollution, urbanization).
Strongly disagree 1 2 3 4 5 Strongly agree

8. How often do you talk about environmental issues that you might learn about in class with a friend, peer or family member?
Never 1 2 3 4 5 Very Often

9. How often do you talk about climate change or environmental topics in your social science/history classes?
Never 1 2 3 4 5 Very Often

10. How often do you talk about climate change or environmental topics in any extracurriculars/clubs/organizations you are a part of?
Never 1 2 3 4 5 Very Often

11. How often do you talk about climate change or environmental topics in your science classes?
Never 1 2 3 4 5 Very Often

12. I am aware of environmental issues affecting my local community and could confidently discuss them with a friend, peer or relative.
Strongly disagree 1 2 3 4 5 Strongly agree

13. I think that human lives and well-being depend on earth's natural resources (e.g. soil, fresh water).
Strongly disagree 1 2 3 4 5 Strongly agree

14. I think that an environmental issue in one environment can affect the health of another environment (e.g. car pollution effects ocean health).
Strongly disagree 1 2 3 4 5 Strongly agree

15. My actions/behavior/habits impact the environment...
5 mi away
25 mi away
100 mi away
1000 mi away
+100,000 mi away

16. I believe that changing my personal habits and lifestyle can impact the health of the environment.
Strongly disagree 1 2 3 4 5 Strongly agree

17. I always recycle and avoid throwing things away in the landfill when possible.
Strongly disagree 1 2 3 4 5 Strongly agree

18. I think that it is important to talk about environmental issues with other people so that we can learn together.
Strongly disagree 1 2 3 4 5 Strongly agree

19. I think that my behaviors and actions can inspire other individuals to make changes to their own habits and lifestyle.
Strongly disagree 1 2 3 4 5 Strongly agree

20. I believe that advances in technology can help decrease the effects of climate change.
Strongly disagree 1 2 3 4 5 Strongly agree

21. I believe that government policy can help decrease the effects of climate change over time.
Strongly disagree 1 2 3 4 5 Strongly agree

22. I am concerned about global climate change and I believe that there are achievable solutions to help us avoid the negative effects of it.
Strongly disagree 1 2 3 4 5 Strongly agree

23. I am upset if I see someone litter or leave their trash behind.
Strongly disagree 1 2 3 4 5 Strongly agree

24. Learning about environmental topics in class makes me care more about the health of my local community and environment. (If you do not learn about environmental topics in class, do not respond to this question)
Strongly disagree 1 2 3 4 5 Strongly agree

25. Learning about environmental topics in class makes me want to take action and make a positive impact on my local community and environment. (If you do not learn about environmental topics in class, do not respond to this question)
Strongly disagree 1 2 3 4 5 Strongly agree

26. Is it important to you there are parks near your home?
Strongly disagree 1 2 3 4 5 Strongly agree

27. Is it important to you that your nearby city streets, parks, and beaches stay clean?
Strongly disagree 1 2 3 4 5 Strongly agree

28. Do you volunteer or participate in any environmental clubs/societies/activities?
Never 1 2 3 4 5 Very Often

29. I investigate a source's credibility or reputation if a particular article, episode, etc. uses strong language or doesn't have professional citations.
Strongly disagree 1 2 3 4 5 Strongly agree

30. If I don't understand a topic the first time I hear it in class, I talk through my confusion with a peer, friend, teacher or relative.
Strongly disagree 1 2 3 4 5 Strongly agree

31.When I learn about a certain environmental topic in class, I think about the ways in

which relates to my personal life.
Strongly disagree 1 2 3 4 5 Strongly agree

32. When I visit a nature site, museum, aquarium, etc. I find myself remembering things
I learned in class and thinking about the ways that my knowledge in class relates to
the things I observe.
Strongly disagree 1 2 3 4 5 Strongly agree

33. I feel excited to learn more about the environment after my class goes on field trips to local nature sites.
Strongly disagree 1 2 3 4 5 Strongly agree

34. After hearing about something in the news from a peer, friend or relative, I do my
own research online to investigate the topic more.
Strongly disagree 1 2 3 4 5 Strongly agree

35. On average, how often do you visit nearby natural spaces (e.g.
parks/beaches/forests/trails/lakes)?
More than once a week
Once a week
Once every two weeks
Once a month
A few times a year
Once a year
Never

36. How do you learn about the environment outside of school? (Check all that apply)
Television News
Online
Friends/relatives/peers
Books
Magazines
Radio
Movies/documentaries
National Parks
Clubs/groups/summer camps/etc.
Museums/conservation centers
Other (specify)

37. What is your favorite way to learn about the environment or climate change?
(Check all that apply)
Outdoor education/field trips
Movies/documentaries
Museums/conservation centers
Online
Class
Visit national parks/nature reserves
Discuss with classmates/friends/relatives
Experiments
Other

38. What is the most memorable outdoor experience/field trip that you remember
during your middle school education? If you have not gone on a field trip, write
"None." (short answer)