Black, Green, and Young: A Case Study Assessing Implementation and Outcomes of an Environmental Science, Technology, Engineering and Math Curriculum for Youth in West Oakland, California

Ashari A. Taylor-Watson
San Jose State University

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BLACK, GREEN, AND YOUNG: A CASE STUDY ASSESSING IMPLEMENTATION AND OUTCOMES OF AN ENVIRONMENTAL SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH CURRICULUM FOR YOUTH IN WEST OAKLAND, CALIFORNIA

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In Partial Fulfillment

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Master of Science

by

Ashari Taylor-Watson

December 2022
The Designated Thesis Committee Approves the Thesis Titled

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by

Ashari Taylor-Watson

APPROVED FOR THE DEPARTMENT OF ENVIRONMENTAL STUDIES

SAN JOSÉ STATE UNIVERSITY

December 2022

Rachel O’Malley, Ph.D.       Department of Environmental Studies
William Russell, Ph.D.      Department of Environmental Studies
Carolina Prado, Ph.D.       Department of Environmental Studies
ABSTRACT

BLACK, GREEN, AND YOUNG: A CASE STUDY ASSESSING IMPLEMENTATION AND OUTCOMES OF AN ENVIRONMENTAL SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH CURRICULUM FOR YOUTH IN WEST OAKLAND, CALIFORNIA

by Ashari Taylor-Watson

Environmental racism plagues low-income communities of color through exposure to environmental hazards, and the youth are most vulnerable. Environmental science, technology, engineering, and math (E-STEM) curriculums promoted as tools for corrective justice. Using a West Oakland, California Boys and Girls Club as a case study, I first describe the environmental awareness, attitudes, and actions of a group of six- to 13-year-old, predominantly African - American, children from this low-income community. I then examine the possible impacts of an E-STEM curriculum on participants, and I identify staff- and researcher-identified challenges to its implementation. During the study, the cohort experienced a heightened need for resilience in the face of external trauma, including but not limited to, a global pandemic. I found that these youths’ environmental awareness fell into three major themes: plants and animals, ecosystem services and earth and the outdoors. Their attitudes were shaped by their feelings toward the outdoors: positive feelings toward exploration versus negativity toward discomfort, and their environmental actions were tied to their intrinsic confidence and sense of agency or to the opportunity to join with a group. Program challenges included poor technology access and parent involvement, inadequate cultural relevance of the curriculum, and insufficient mentorship relationships. To succeed as a tool for corrective justice, I find that Club staff should be involved in E-STEM curriculum development, and the program should include funding for equipment and staff time.
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# Table of Contents

List of Figures ............................................................................................................ viii

Introduction ............................................................................................................. 1

Literature Review .................................................................................................... 2
  Racism ................................................................................................................. 2
  Environmental Racism and Inequities ................................................................ 2
  Environmental Justice History and Movements ............................................. 3
  Environmental Justice as a Framework ......................................................... 4
  Environmental Education .................................................................................. 6
  Disparities in Environmental Education ......................................................... 7
  Environmental Education and Successful Influences .................................. 7
  Achieving Environmental Justice in the Context of Trauma ....................... 8

Problem Statement ................................................................................................ 9

Research Objective and Questions ........................................................................ 10
  Research Questions: ............................................................................................ 10

Methods ..................................................................................................................... 11
  Study System ........................................................................................................ 11
  Study Design .......................................................................................................... 16
  Data Collection ...................................................................................................... 20
  Data Analysis ........................................................................................................ 23

Results ....................................................................................................................... 24
  RQ1: Environmental Awareness, Attitudes, and Actions ........................... 24
  RQ2: Curriculum Impact ..................................................................................... 30
  RQ3: Staff- and Researcher- Identified Challenges ........................................ 32

Discussion ................................................................................................................ 37

Conclusion ............................................................................................................... 46

Recommendations .................................................................................................. 48

References ................................................................................................................. 50
Appendices

Appendix A: 2019 Research Recruitment Speech Script
Appendix B: Parental/Guardian Consent Form
Appendix C: Assent Form
Appendix D: Survey/Interview Questions
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.</td>
<td>Entrance of the Leonard J. Metzler Boys and Girls Club of West Oakland...</td>
<td>13</td>
</tr>
<tr>
<td>Figure 2.</td>
<td>Warriors-Funded Amenities</td>
<td>14</td>
</tr>
<tr>
<td>Figure 3.</td>
<td>USA Food Convenience Store</td>
<td>15</td>
</tr>
<tr>
<td>Figure 4.</td>
<td>The Branch Corner of Market and 24th Street.</td>
<td>15</td>
</tr>
<tr>
<td>Figure 5.</td>
<td>Study Design</td>
<td>18</td>
</tr>
<tr>
<td>Figure 6.</td>
<td>Second Computer Lab/Testing Computer Lab</td>
<td>22</td>
</tr>
</tbody>
</table>
Introduction

Racism is an ideology and systematic practice embedded in all aspects of the American cultural system (Cress-Welsing, 1991, p. 301). Racism often manifests in poor environmental quality and disproportionate exposure to environmental hazards (Bullard, 2003, pp. 1183-1209). Over time, as the environment is degraded, so is the public health of the residents of that community, causing generational trauma (Northridge & Shepard, 1997, pp. 730-732). Populations born into environmental racism and excess exposure to environmental hazards can achieve equality and health of their environment through access to and implementation of an environmental education curriculum to teach and foster positive environmental actions. Environmental education taught through a curriculum centered on environmental science, technology, engineering, and math (E-STEM) could be beneficial due to the problem-solving content in the intersections of nature and technology. In principle, an E-STEM curriculum taught to a vulnerable population of low-income children of color could be a positive intervention that creates, informs, and equips future generations of pro-environmental actors. Even though the curriculum is designed to create a positive outcome for the participants, this result is not guaranteed. Outcomes must be studied and reported to assess whether curriculums serve underrepresented audiences.
Literature Review

Racism

Since the founding of the United States of America, racism has been a significant factor that affects how people access societal resources by locking specific classes to the bottom of the social structure based on their race (Cress-Welsing, 1991, p. 301). Laws and culture enforce this hierarchy, determining who can participate fully in politics, economy, and society (Simmons, 2002, p. 29). In addition, racism also systematically determines the health of communities’ natural environments based on ethnicity and skin tone (Bullard, 1993; Doane, 2006, pp. 255-274).

Environmental Racism and Inequities


Environmental inequity is an unequal exposure to an environmental hazard that is systematically enforced by institutions based on communities’ racial and or economic demographic (Brulle & Pellow, 2006, pp. 103-124). Environmental inequities include unequal access to pro-environmental resources (Bullard, 2003, pp. 1183-1209).
Environmental inequities are persistent issues that historically have become multi-
genерational, negatively impacting individuals, their children, and grandchildren in the
affected environment (Kahn, 2002, pp. 93-96).

Another major determinant of environmental inequality is class or socioeconomic status
(SES), which includes income and financial position (Bullard, 2003, pp. 1183-1209).
Although SES is not independent of race, regardless of SES, race independently increases
exposure to environmental hazards and decreases the adequacy of healthcare (Bullard et al.,

Environmental Justice History and Movements

Environmental racism creates environmental injustices. Environmental justice is the
solution to address the environmental racism that causes inequities. Environmental justice
began as a movement that was converted into a framework through legal processes and
procedures to correct environmental injustices. The environmental justice movement did not
arise from one specific event but from many incidents steeped in environmental racism and
other injustices that inspired community activism (Cole & Foster, 2001, pp. 1-4,6,12,20).
Multiple scholars have argued that environmental justice history has no specific start but
comprises many incidents and actions that feed into the overall discourse and subject (Cole,

The pattern of disenfranchised minority communities organizing and mobilizing against
unequal exposure to environmental hazards despite deliberate non-acknowledgment and lack
of aid from government institutions was the catalyst for the environmental justice movement
(Cole & Foster, 2001, pp. 1-4,6,12,20). The Anti-Toxic and Civil Rights movements were
catalysts for the environmental justice framework because they understood and adopted a model of racism and economic oppression as a common denominator against their community (Bowen & Wells, 2002, pp. 1-11).

A landmark event occurred in 1987 when the United Church of Christ’s Commission for Racial Justice issued a report, “Toxic Waste and Race in the United States,” which found that race was the primary factor in unequal exposure to environmental hazards (Hieman, 1996). This report was a catalyst for environmental disparity studies by academic institutions and government agencies to analyze environmental inequities based on structural racism (Hieman, 1996). The research showed that race was the common factor in exposure to environmental hazards across the United States (Bryant & Mohai, 1992, p. 922).

Bowen and Wells (2002) reported that academics in the late 1980s and early 1990s began to identify and research environmental inequities, which helped legitimize environmental organizations’ ability to support their concerns with factual data on disparities (pp. 1-11). This new practice and collecting data on environmental injustices caused activist groups to challenge racist environmental hazards through legal action by pressuring politicians to create new policies to protect communities’ environmental rights (Bullard & Johnson, 2001, pp. 555-578).

**Environmental Justice as a Framework.**

New local and state regulations prompted the federal government to address the disparities on a national level. In 1994, President Clinton issued Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations – to focus the federal government’s resources on protecting low-income and
minority communities from extreme environmental hazards (U.S. Environmental Protection Agency [EPA], 2022). Executive Order 12898 was the first time in the American social landscape that lawmakers began to recognize environmental justice rights for all citizens, regardless of race and SES (Bas, 1998, pp. 83-92). The EPA’s 2020 definition of environmental justice includes “the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, for the development, implementation, and enforcement of environmental laws, regulations, and policies.” Since 1994, the federal public policy created by the EPA has given environmental justice a framework by utilizing government resources to identify, investigate, and address environmental inequities and hazards (EPA, 2022).

According to Walker (2012, p. 151), specific terms were developed for environmental justice as a framework for change in communities by “Making claims,” which is a critical term that consists of “Justice: how things ought to be; evidence: how things are; and process: why things are how they are.” Making claims is foundational to addressing environmental justice issues, and once claims are made, communities strive to achieve distributive, procedural, and corrective justice (Walker, 2012, p.151).

Scholars define distributive justice as “equality with environmental hazards, waste facilities, and other potentially threatening environmental stressors equally, regardless of community race and socioeconomic status (SES)”; procedural justice as “equitable treatment of all people in the context of government, law, and policy for environmental hazards”; and corrective justice as “the overall process of addressing environmental racism and inequities for injustice in a community” (Neal & Palmer, 1994, p. 510). The concept of corrective

**Environmental Education**

Environmental education is a process that allows individuals to explore environmental issues, engage in problem-solving, and take action to improve the environment (EPA, 2022). Environmental education's main benefit is that participants gain the skills to make informed and responsible environmental decisions (Athman & Monroe, 2001, p. 14). Another goal of an effective environmental education curriculum is to allow participants to reconnect with nature and regain the benefits that participants have experienced in the past (Weeks, 2011, p. 571).

Curriculum designed for environmental education can be broad and cover many topics discussing the natural environment and human-made environmental structures (Dillon, 2014, p. 18). According to the EPA (2022), the critical components of an environmental education curriculum are awareness and sensitivity, knowledge and understanding, attitudes, skills, and participation in relating to the natural environment. These concepts have frequently been summarized in academic literature under the categories of “environmental literacy” or “environmental awareness, attitudes, and actions” (Rowe, 2002, pp. 79-103; Scholz & Binder, 2011, p. 631).

An environmental education curriculum is different from environmental information because the goal of an environmental education curriculum is to inspire action rather than to inform. Kudryavtsev et al. (2012, pp. 229-250) state that one purpose of environmental education curriculum is to gain a sense of place in nature, to feel connected, and to inspire
positive actions toward the environment. Bonnett (2015) states that another main goal of environmental education is to create and strengthen an evolving relationship between the individual and their environment.

**Disparities in Environmental Education**

Johnson et al. (2001) and Jones and Rainey (2006, p. 4) found that as the United States continues to diversify, race, gender, age, and ethnicity will continually play a part in different communities' environmental awareness, attitudes, and actions. Kahn (2002, pp. 93-96) and Coyle (2005, p. 152) found that constant disconnects between nature and youth can cause issues of physical, social, and psychological well-being. The benefits for dominant cultural groups are well researched from receiving an environmental education; however, due to environmental racism; still disparities in accessing those benefits remain across underrepresented communities (Brown & Bullard, 2001, p. 510). Fisman, 2005, pp. 39-50; Jones and Rainey’s (2006) research explains how environmental racism impacts minority children due to fewer opportunities and less access to natural spaces, resulting in less likelihood of changing their environmental attitudes. A 2020 study conducted by Sprague et al. reported that children from a low-income background and children of color experience disparities in health, environmental education, and access to nature compared to white children and communities and described how these deficits affect the children’s environmental awareness, attitudes, and actions (Sprauge, et al. 2020).

**Environmental Education and Successful Influences**

Environmental education is based on fundamental concepts which must be measured to show growth (Dillon, 2014, p. 18). Once an environmental education curriculum has been
administered, ideally, the participants should be closer to their natural environment and be more prone to act with pro-environmental behavior (Kudryavtsev et al., 2012, pp. 229-250). Larson et al. (2010, pp., 95-113) assert that environmental education can help with this deficit. They explain that it is problematic that more research does not consider the many factors outside of the environmental education intervention that influences the understanding & experience of nature among populations that have been economically or socially marginalized (Larson et al., 2010, pp. 95-113). Losada et al. (2015, pp. 390-421) found that environmental education curriculums have more success for the participant when the activities can be community-based. Factors such as time and educational materials were found by Jelavic (2014) to be successful outside influences for environmental education.

**Achieving Environmental Justice in the Context of Trauma**

Achieving environmental justice and pro-environmental actions through an environmental education curriculum will only work for youth from a disenfranchised population if all factors that create trauma resilience are considered and reported (Anguelovski, 2013, p. 2). Neal and Palmer (1994, p. 288) state that all environmental education implementation and assessment factors should be noted because the goal is to understand nature, positive feelings, and actions towards nature, even if unrelated to the curriculum. Specifically, McPhearson and Tidball (2013) cite the unique opportunity and benefit of assessing an environmental curriculum after an ecological trauma to document and measure the community's adaptability and response to their environment.
Problem Statement

Ideally, an environmental curriculum designed to inform, equip, and empower children from a low-income community of color through E-STEM training should be able to achieve its goals of creating pro-environmental feelings and actions and future pro-environmental behavior. Keeping vulnerable populations connected to nature and the environmental curriculum throughout a community and global trauma such as a pandemic needs more assessment than just curriculum review. By assessing the outcome of an E-STEM curriculum under circumstances of trauma and community change that make it difficult for the population to adapt and learn, I evaluate how well an E-STEM curriculum benefits the intended population or their environment or contributes to corrective justice under real-world conditions.
Research Objective and Questions

The objectives of this research were (a) to describe the current environmental understanding of six- to 13-year-olds from a low-income, predominantly African-American community of color in west Oakland, California, (b) to identify the impact of exposure to environmental science, technology, engineering, and math (E-STEM) curriculum at a non-profit after-school program on all participants’ resilience to the trauma of a global pandemic and ability to stay connected to the curriculum and their environment (c) to identify staff- and researcher-identified challenges that arose as emergent themes that affected participants’ positions and responses in this study outside of the E-STEM curriculum.

Research Questions:

- **RQ1:** What are the pre-pandemic environmental awareness, environmental attitudes, and environmental actions in a population of six- to 13-year-olds from a predominantly African American low-income community of color in west Oakland, CA?

- **RQ2:** How did exposure to an E-STEM curriculum impact participants' resilience to community and global trauma and ability to stay connected to the environmental curriculum and their environment?

- **RQ3:** What are the staff- and researcher-identified challenges related to and outside the E-STEM curriculum?
Methods

Study System

Study Site

This research was completed in northern California, in the city of Oakland. Oakland is located east of San Francisco Bay and has a land area of 53.8 square miles (140 km²). The eighth largest city in California, Oakland, has a population of 433,697 (U.S Census Bureau, 2022). According to the 2020 census, Oakland was 36.14% White, 23.61% Black or African American, 15.72% Asian, 0.91% Native American, 0.063% Native Hawaiian or pacific islander, and 16.14% other race. The median age was 36.5. The average median household income in Oakland was $101,853 and the poverty rate was 17.63% (U.S. Census Bureau, 2022).

According to the City of Oakland’s Open Data Forum and Oakland Equity Indicators (2021), racial and ethnic groups differ in business development, employment, financial health, and job quality (City of Oakland’s Open Data Forum and Oakland Equity Indicators, 2021). In 2022, African - Americans are the most likely to be unemployed (8.9%), while Whites are the least likely to be unemployed (4.2%). African - Americans were 2.212 times more likely than Whites to be unemployed. City-wide, one in 10 youth was neither working nor in school (City of Oakland’s Open Data Forum and Oakland Equity Indicators, 2021). African - American youth were the most likely to be disconnected, at 14.8%: African - American youth were 2.80 times more likely to be disconnected from school and work than Whites. Racial and ethnic minorities also face inequities in housing related to affordability, displacement, essential services, and housing quality. African - American households were
1.70 times less likely to own their homes than white households. Inequities faced by racial and ethnic minorities in the neighborhood and civic life include built environments, civic engagement, environmental health, and transportation and infrastructure (Oakland Equity Indicators, n.d.; City of Oakland’s Open Data Forum and Oakland Equity Indicators, 2021).

The research was conducted in the west Oakland neighborhood, in the northwestern corner of downtown Oakland, south of Emeryville, and north of Alameda. West Oakland encompasses the waterfront from the Port of Oakland to the eastern end of the San Francisco-Oakland Bay Bridge. West Oakland is historically Black due to the second great migration of African-Americans from the south to the north and the western U.S., who came in the early 1900s searching for safety, economic opportunity, and social growth. West Oakland is a predominantly low-income community, with approximately 52% of the population living below the Bay Area poverty level, compared to 25% in Alameda County and 23% in the San Francisco Bay Area as a whole (City of Oakland’s Open Data Forum and Oakland Equity Indicators, 2021).

I chose to work with the Boys and Girls Club of America (BGCA) because of its social justice advocacy values and goals. According to its website, the club is a “non-profit organization that creates centers in low-income neighborhoods to help serve disadvantaged communities through community involvement in youth empowerment programs (Boys and Girls Club, n.d.). The BGCA's natural mission includes “the effort to empower and enhance these children’s lives by providing a safe space for six- to 17-year-olds by creating programs and fostering ongoing caring relationships with professional adults to help develop the character of each child.” (Boys and Girls Club, n.d.). I chose the Leonard J. Metzler West
Oakland branch of the BGCA, located at 920 24th street, for this participant action research (Figure 1).

**Figure 1.**

*Entrance of the Leonard J. Metzler Boys and Girls Club of West Oakland*

![Image of the entrance to the Leonard J. Metzler Boys and Girls Club of West Oakland.](image)


I chose this branch because it offered an E-STEM curriculum to youth from low-income, predominantly African American communities of color. The apparent environmental justice issues surrounding this branch made it favorable to study and invest in the E-STEM curriculum. Other reasons for choosing this location included the history of environmental
justice groups, the content of the curriculum, and the proximity to Silicon Valley. The Bay area basketball franchise, The Warriors, has also previously invested in this branch through funds for a computer lab (Figure 2A) and a mural (Figure 2B), and I wanted to see if the investment was beneficial.

**Figure 2.**

*Warriors-Funded Amenities*

A. Computer lab.                                             B. Mural


The conditions of the neighborhood and the environment around the club are essential to note. A house that is known for supporting illegal drug-related activities (personal communication who?) is located on the corner of the same block of 24th street as the Club. Green space is absent around the club, and sidewalks are riddled with trash, litter, and glass. Directly across the street, BGCA participants often patronize a convenience store for snacks only offers processed foods and snacks (Figure 3).
Figure 3.

USA Food Convenience Store

Note. By Taylor-Watson, A. (2019), U.S.A Food Mart, picture, located at 2408 Market Street, Oakland, CA, United States. The intersection between Market Street and 24th street (Figure 4) near the BGCA is dangerous, and I have seen hit-and-run accidents at this corner.

Figure 4.

The Branch Corner of Market and 24th Street.

Environmental Curriculum: STEM Mentoring

The Sea Research Foundation (SRF), a non-profit organization focused on conservation, education, research, and youth development, designed the STEM Mentoring curriculum (Sea Research Foundation, 2020). The curriculum, funded by the Department of Justice and the Department of Juvenile Justice, is a corrective justice curriculum designed to help participants aged six- to 10 years old in disenfranchised communities mitigate the deficit of poor environmental education curriculums in their school systems. The curriculum is designed to provide fun, hands-on group projects and multi-media connections through various STEM topics focused on conservation (Sea Research Foundation, 2020).

The program was developed in 2019 to be administered in the 2020 academic calendar year of the BGCA between November and February. The specific curriculum was “Energy Engineers,” which focused on renewable resources and green technology around those resources. The Energy Engineers learning objective was “to explore renewable energy: what it is, where to find it, and how to use it.” The curriculum had six lessons about “Energy from the Sun, Earth, Biomass, Water, and Wind, and the goal of creating energy savers.” Each participant was given a workbook with an online code and the opportunity to make an online account with the E-STEM Mentoring website for remote learning (Sea Research Foundation, 2020). The BGCA staff provided scheduled classes on Fridays between 5 pm and 6 pm.

Study Design

Case Study

This research used a qualitative case study design: an in-depth description and analysis of a bounded system. My case was a group of six- to 13-year-old mostly African - American
youths, bounded through their enrollment in the Leonard J. Metzler branch of the BGCA. The case study approach was most appropriate for this study because of my goals to answer questions about how and why the curriculum did or did not affect these participants' environmental awareness, attitudes, and actions. Creswell (2013) identifies that with case study research methodology, the researcher “explores a real-life contemporary case...through detailed, in-depth data collection involving multiple sources of information.” Case study research happens within the natural context of the phenomenon under investigation (Yin, 2003). In this case, my research documents the natural context of implementing the E-STEM curriculum at the Leonard J. Metzler branch BGCA in West Oakland.

The study began when I volunteered with the BGCA as an academic mentor for all club participants in the spring of 2018. To volunteer at the Leonard J. Metzler branch, I completed a volunteer application and a background check, including understanding the national BGCA branch volunteer policy. Once the background check was completed and accepted by the BGCA local headquarters, I began volunteering twice a week, Tuesdays, and Fridays, between 3:30 and 7:30 pm, to help with overall club operations, including check-in, check-out, supervising, and homework help (academic tutor) for all participants. While volunteering, I learned about the annual E-STEM curriculum. I asked the Branch Director whether she would like me to volunteer as the E-STEM instructor, and she agreed to allow me to teach the program.
As the E-STEM teacher, I first familiarized myself with the curriculum. I constructed the research recruitment speech, permission consent, and assent forms for the participants and participants’ parents or guardians (Appendices A, B, and C) to explain the research. I then developed the survey and interview questions (Appendix D) and submitted a full proposal to San Jose State University’s Institutional Review Board (IRB) for permission to conduct research. As I observed BCGA operations, I developed a study design to assess the potential effects of the E-STEM curriculum (Figure 5).
I formed two groups of BGCA attendees, comprising 17 E-STEM participants and 16 non-participants, and pre-surveyed them before implementing the E-STEM curriculum. Initial assessments included semi-structured interviews and computer-generated surveys that began on December 2, 2019, and continued until January 13, 2020.

I also observed participants, their families, BGCA staff, and the neighborhood and environmental conditions opportunistically in person during the pre-assessment and throughout the E-STEM class. Due to the Covid-19 pandemic, the branch closed from March through October 2020. This disturbance influenced the study design. Because of the Covid-19 restrictions, attendance limitations affected the post-assessment plan. I administered final assessment interviews and observations for only three E-STEM participants and four non-participants on-site in the club between December 3 and 7, 2020. During those last dates, I also interviewed three BGCA staff, including the Director, Co-Director, and a junior staff member.

I used all the data I collected to address my first research question. Still, due to the poor ratio of pre-assessment data to post-assessment data, insights into research question two were derived from the seven participants I could gain from their post-surveys and interviews when the club re-opened after the pandemic closure. After reviewing the transcripts, I developed the third research question, which recorded staff and researcher-identified challenges. I identified emergent themes that seemed to make the participants resilient to dealing with the trauma of the Covid-19 pandemic and still engaged with nature and E-STEM material.
Data Collection

Participant Selection and Recruitment Strategy

I worked with the BGCA staff to promote the research project. While working at the front desk, I had access to the families of every participant from age six to 13 and spoke to them about participating in my study. BGCA staff also helped administer and explain the permission forms to possible participants and their families when I was not there.

After receiving signed permission and consent forms, I haphazardly assigned each participant to either the E-STEM or the Non-E-STEM group. I assigned participants to each group, alternating based on when I received the permission forms. Exceptions were only made for sibling consideration, for the convenience of parent/guardians' schedules, for whom I would assign two or three participants at a time to one group. While collecting permission forms, I planned out the lessons for the E-STEM curriculum and the survey schedule. I began making observations by writing down what I saw and thought about anything relevant to the E-STEM curriculum and the participants, parents, and staff’s environmental awareness, attitudes, and actions. The assessment began after each participant returned their signed permission form to ensure that all participants’ rights were protected, and results were documented.

Pre-Surveys and Interviews

Once every permission form was signed and collected, I began the pre-survey and interviews aspect of the data collection. Participant interviews were conducted immediately after the online surveys in the same setting. The participants were encouraged to speak freely and honestly and explain their understanding of environmental awareness, attitudes, and
actions. The open-ended question prompts included “What is nature? Is it important, why, or why not?” and “Can you name an example of where nature and technology come together?” (Appendix D). I noted how comfortable the participants were answering questions and accessing the survey as an online component for E-STEM. I administered surveys and interviews one-on-one and collected responses through Qualtrics software using the second computer lab (Figure 6) at the Leonard J. Metzler branch.

The Qualtrics survey interview helped to guide and foster a conversation about environmental awareness, attitudes, and action themes. The survey included information and questions from the E-STEM curriculum with specific terms and lessons such as solar technology and clean water availability. The survey also included questions about attitudes and actions that the participants would or would not engage in, to open a conversation about their relationship with their environment.

There was no time limit. The survey ranged from four to 20 minutes. I read the questions aloud to the participants to ensure they understood them. I answered their questions about wording if they arose and observed their computer skills and confidence. I wrote notes on each participant's permission forms to ensure the correct response was recorded for each participant. The process was recorded on my iPhone, starting when the participant sat down.

Staff interviews were held one day at the BGCA in the branch director's office. Staff interviews ranged from two to 11 minutes. The staff prompt interview (Appendix D) included demographics and curriculum implementation questions. All staff observations were recorded on paper, including statements related to the study. These interviews were also recorded on my iPhone voice recorder application to be uploaded for transcripts.
Figure 6.

Second Computer Lab/Testing Computer Lab

A. Left computer row

B. Right computer row, survey computer

Note. By Taylor-Watson, A. (2019), Second Computer lab, picture, located at 920 24th Market Street, Oakland, CA, United States.

Qualitative data were collected through participant observations of all participants, families, and staff. Participant observations were collected throughout my time as the E-STEM curriculum volunteer. They consisted of me taking notes on the participants’ words and actions that pertained to the E-STEM program and the participants’ community environmental awareness, attitudes, and actions. I wrote observations and notes for each student on their permission form with the date for my comments, and I stapled survey interview answers to each slip. Also, on the same sheet, I wrote field notes on each participant, including their parent/family dynamic, club attendance, personality, diet, club behavior, interests, relationship with the interviewer, and relationship with staff. I wrote down everything I thought was important regarding this study and notes about each participant. Observations collected throughout the E-STEM classes included the amount of
comfort, confidence, and enthusiasm each participant showed while completing the curriculum. I wrote specific examples of when participants commented on the E-STEM curriculum and nature, added it to their observations, and logged it as my overall data.

**Data Analysis**

After collecting interviews and observations, I uploaded the recordings into the transcript software, Otter.ai intelligence (https://otter.ai; Otter.ai, n.d.). This website and software transcribed each interview individually. I printed out the transcripts from this software to manually paper code using a marker to highlight specific words and themes. I also used my field notes of observations of participants, staff, and parents/guardians to analyze and code into qualitative themes.

To analyze my interviews and observations, I first coded the common themes and concepts related to environmental awareness, environmental attitudes, and environmental actions by actively searching for patterns related to environmental awareness, attitudes, and actions. Then I used the inductive technique of thematic coding to analyze interviews, transcripts, and observations to find new emergent themes that explained relationships with the E-STEM curriculum over time and through the trauma of the COVID-19 pandemic. Thematic coding helps develop a coherent narrative as “a method for identifying, analyzing, and reporting patterns and themes within data (Braun & Clark, 2006).” The six phases of thematic analysis, as described by Braun and Clark (2006), are to (a) familiarize yourself with the data, (b) generate initial codes, (c) search for themes, (d) review themes, (e) define and name themes, and (f) introduce the report, and this “minimally organizes and describes your data set in (rich) detail.”
Results

RQ1: Environmental Awareness, Attitudes, and Actions

What are the environmental awareness, environmental attitudes, and environmental actions in this subpopulation of six- to 13-year-olds in a low-income community of color?

Environmental Awareness

The participants' environmental awareness varied, but I found three specific recurring themes that categorized their understanding and knowledge of the environment. The main themes relating to environmental awareness were: plants and animals, ecosystem services, and earth and outdoors.

A. Plants and Animals. Overall, participants identified the environment with plants, animals, and or plants and animals throughout the coded transcripts. Their responses were broken into three categories of animals, plants, and plants and animals, then coded under plants and animals.

In response to the question, “What is nature?” the theme of plants and animals was evident in the following examples. Animal responses included a nine-year-old boy who stated, “birds, bees, rabbits,” and a nine-year-old girl who identified “places where animals live.” Four participants spoke about plants, including a boy who was nine years old, who stated, “Nature is trees, grass, flowers, rain, and clouds,” and a nine-year-old girl who responded, “Flowers, beautiful trees.” An eight-year-old girl similarly identified “Plants, weeds, suns, grass, sunflowers seeds, and water.” One 10-year-old boy said, “Gardens.” Some participants mentioned both plants and animals. One nine-year-old girl, for example, said, “Plants, water, animals, squirrels, trees.” An 11-year-old boy stated, “Wild animals,
bugs, and you have to travel to nature.” A nine-year-old boy cited, “Bugs, dirt, grass, ground, and earth.” An eight-year-old girl identified “Outside, smells, animals, plants,” and an eight-year-old boy mentioned “Dirt, grass, nature, and animals.” A seven-year-old girl said, “Fresh fruit, vegetables, bugs, and animals,” and a nine-year-old boy described, “Trees, birds, animals, water, forests.”

**B. Ecosystem Services.** The theme of Ecosystem Services frequently emerged in response to the question: What is nature, and is it important? Participants described the environment from the perspective of how nature serves humans or other creatures, including a nine-year-old girl who stated, “Trees make paper, and we need paper.” This participant is very studious and thought about the literal ways nature serves her. An 11-year-old boy noted, “We need air to breathe.” A 12-year-old boy observed, “We need to live somewhere. We need the world to live.” A nine-year-old girl who could see both the practical and intrinsic value of nature stated, “We need nature to live, and it is pretty by itself.” An eight-year-old girl observed, “We need to grow in nature to eat.” A bright 10-year-old boy whose family often attended the BGCA during homework time suggested, “We need CO2 to breathe.” His observation showed awareness of the importance of the air environment for humans. Finally, an 11-year-old girl stated, “Keep the planet alive for animals,” reflecting her understanding of the importance of ecosystem services for non-humans.

**C. Earth and Outdoors.** The third Environmental Awareness theme that I coded was Earth and Outdoors. These participants primarily associated the environment with the whole planet or earth or with the outdoors representing nature. Responses ranged from “Outside, plants, wheat” from an eight-year-old girl to a nine-year-old boy who observed, “Nature is

Environmental Attitudes

The environmental attitude themes reflected positive or negative feelings towards interacting with nature and being outside. I identified two articles related to participants' environmental attitudes: Exploration and Discomfort. Individual associations with outdoor nature sparked positive attitudes toward exploration or negative feelings of discomfort.

A. Exploration. The exploration theme developed from responses around their positive feelings about the environment based on exploration and excitement. One nine-year-old boy stated on the exploration theme, “I used to go outside a lot when I was home. It is not as fun here.” This feeling was notable because this participant is from a different country and did not see the west Oakland environment as natural and open as his home country. Another response from a 12-year-old boy expressed positivity about going outside, “I like to see nature, trees and birds,” highlighting the specific aspects of nature he enjoys exploring.” A 10-year-old girl reflected, “I don’t have any money to go to the store today; I just want to leave the club for a while,” showing her interest in being outside because she was uncomfortable being inside the club and wanted to leave to explore. This same sentiment was displayed when a nine-year-old boy said, “STEM is lame, but I want to go outside.” He emphasized that he was not interested in the indoor E-STEM class lesson but in going
outside for exploration. An eight-year-old girl reflected on the value of exploration and stated, “I don’t like nature here, but I liked it when my family and I went to Vegas.” The opportunity to explore when she could leave her community turned her negative effect positive. She was excited and able to enjoy the different terrain. An eight-year-old boy commented, “I like to walk to the store from my house after school. I see birds and stuff.” Again, this response suggests that specific aspects that the participant enjoys exploring, such as birds and wildlife, increased his positive attitude toward his environment. One eight-year-old girl specifically cited the exploration component of the E-STEM curriculum: “It was cool to go outside and make those radios.” She expressed that the E-STEM lesson was fun, and she enjoyed the lesson outside the club.

B. Discomfort. An adverse environmental attitude theme arose from participants’ statements that implied that nature would cause them discomfort, resulting in antipathy to the natural environment. Participants expressed this concern: An eight-year-old girl stated, “I don’t want to go outside and get my shoes dirty.” Going outside towards nature seemed to threaten her cleanliness and made her uncomfortable. The same sentiment is highlighted when an 11-year-old girl answered my question about wanting to go outside for a class when she stated, “No one wants to go outside, Ms., and get dirty?” This same student also said that “trash feels bad” when discussing environmental “goods and bads” in an E-STEM lesson.

Other participants were less clear about why going outside provoked discomfort, but they were clear that they were not comfortable with the natural environment. A 10-year-old boy stated, “No, I don’t want to go outside. No Nature.” His answer, although somewhat sarcastic, revealed considerable discomfort with the outside world. It is relevant here to
mention the lack of green space around the BGCA branch. The environment outside of the club can be dangerous and dirty. A seven-year-old girl observed, “There are beautiful things outside, but I don’t want to go out there that much,” reflecting that she enjoyed the idea of nature but was uncomfortable in her environment. She described nature as something she was separate from. An eight-year-old girl reported, “I don’t go outside. I stay in my room on my phone.” A nine-year-old girl expressed that the outside environment was not exciting and would bring her discomfort through boredom: “No, I don’t really like to go outside. It’s nothing to do.”

Environmental Actions

The themes I found most associated with environmental actions were Confidence and Agency and Group Activities experience. Confidence and Agency reflected participants’ confidence in their ability to be pro-environmental actors. The Group Activities theme described participants who engaged with the environment through community actions and cultural events.

A. Confidence and Agency. Confidence and agency were related to the participant’s personalities and belief in their ability to influence their environment, both positive and negative. The theme primarily emerged from my observations of student behaviors and interactions related to their stated environmental activity. This theme was found when participants expressed having pro-environmental behavior with either future confidence or having gained confidence from past experiences.

For example, a 12-year-old girl who comes across as confident and is very sociable at the club and enjoys activities that she can complete with her friends saw herself as possibly
being an influential actor in her environment. In response to a question about cleaning up a park as a club field trip, she replied, “I think that's a good idea. Cleaning up the parks would be cool.” In contrast, a nine-year-old boy who is quiet and shy when interacting with his peers is not very social and has trouble communicating his wants and needs answered the prompt survey question out loud with, “People wouldn’t listen if I told them to recycle.” This participant's lack of confidence undermined his likelihood of future pro-environmental actions. Other participants reflected an intermediate level of confidence and environmental activity. A nine-year-old girl in the E-STEM class expressed her confidence and agency in the school environment. She was very interested in the recycling lesson. However, she noted: “I try to recycle at school, but I do school from home now.” This participant was less confident of her agency in the home environment than at school. Her confidence wavered in different settings and affected her environmental behaviors. The following response expressed how a participant answered with self-confidence from past experiences: a 12-year-old boy stated, “I’ve done a beach clean-up before, and I would do it again.” Because he has interacted with nature in the past, he feels more comfortable being influential.

B. Group Activities. The second environmental action theme I identified I categorized under Group activities. One nine-year-old girl talked about past trips that the Boys and Girls Bub had conducted, reporting, “We went fishing, and that was fun.” She associated positive interactions with nature and environmental action of a specific activity she enjoyed with a group of people, emphasizing “we.” An eight-year-old girl stated the same sentiment and expressed how her community was a part of her environmental actions when she said, “I like going to the park with my cousin. We have fun playing outside.” Her response was clear that
when she enjoys and engages and enjoys nature, it is a family event. An eight-year-old boy stated, “It’s only cool when we build stuff, like when we had the Legos.” His recorded response told me which E-STEM class he enjoyed the most. He saw the E-STEM class as a community experience and felt connected through the class activity and effort. He mentioned us as the ones who engaged with nature. The other response expressed pro-environmental action correlated with group activities was stated by a six-year-old boy who said, “My grandma tells me to turn the water off when I’m at her house. I try when I was at my grandma’s.” The participant equated pro-environmental behavior with his community through his family’s cultural norms.

RQ2: Curriculum Impact

How did exposure to an E-STEM Curriculum impact participants' ability to be resilient to trauma and stay connected to their environment?

Overall, the participants benefited by participating in the study by fostering a new conversation around environmental awareness, creating confidence through interviews, and adding a consistent adult to their community throughout the global and community traumas. However, the trauma of the Covid-19 pandemic was more substantial than the curriculum benefits and did not improve pro-environmental behavior in this vulnerable population.

The curriculum was not as important as participation in the research study for the kid’s confidence. There was growth in confidence in all participants' answers in the post-survey. Examples include a non-E-STEM 10-year-old-boy's first interview statement, for the question, “Can you name an example of where technology and nature come together?” was “I don't know.” to the post-interview where he stated, “You can check your location.” He did
not have the intervention of the E-STEM class, but when I was at the club, I often helped him with his homework. A stronger relationship between him and I affected his confidence in answering the question, and he could share his thoughts, which he did not feel during the pre-survey. An eight-year-old boy E-STEM participant went from “I don’t know” to the post-interview, “Solar panels give your house electricity.” An eight-old-year girl E-STEM participant, in the pre-interview, stated, “I don’t know,” to the post-interview, “The wind things.” This participant missed many of the E-STEM classes but was in attendance for a lesson on green technology and told the class she had seen a wind turbine before when she was traveling with her family. She seemed to have more confidence in answering the question in the post-survey due to our improved relationship because we often spoke about food and school.

Exposure to the curriculum helped the participants ability to understand intersectionality. Because the curriculum had two primary components of the natural environment and STEM, it allowed participants to be introduced to intersectionality and showed in their post-creative answers. An example of the impact of understanding intersectionality is in the difference between the first response of a 10-year-old girl E-STEM participant stating, “I don’t know,” to the second response of “It helps plants grow.” This participant enjoyed the lesson on how technology can improve natural processes, including greenhouses, wind turbines, and dams. Another example and response by a participant who was eight-year-old-girl Non-E-STEM participant’s first responders were, “I don’t know,” and her second response stated, “I could ask Siri about nature.” She did not have the intervention of the E-STEM curriculum;
however, because of the survey and interview, she could come up with an answer post-interview that showed her idea of intersectionality.

The curriculum could not be correctly implemented due to the Covid-19 pandemic causing the Club to shut down. The Club shutdown caused the research study to be shortened, which did not precisely allow me to finish conducting research. The curriculum was not strong enough to keep participants resilient through trauma and stay connected to the club, curriculum, and environment. Even though there was a lack of post-data, I found nothing in my observations and interviews that suggested the curriculum helped participants be resilient through traumas to aid in environmental healing.

**RQ3: Staff- and Researcher- Identified Challenges**

*What are the staff- and researcher-identified challenges faced by participants in this E-STEM research study?*

**Staff-Identified Challenges**

My interviews and observations of staff yielded three staff-identified challenges and opportunities for the success of the E-STEM curriculum: technology access, parental/guardian involvement, and staff human resources. All the staff-identified challenges highlight the specific aspects that the staff thought impeded the full implementation of the E-STEM curriculum and study design.

**A. Technology Access.** The staff members often identified poor functionality of technology devices and services, including nonfunctional computers, unreliable club internet connectivity, limited technology understanding, and limited home technology access.
The Leonard J. Metzler BGCA branch had two computer labs with 20 computers for the club goers and one stationary computer for the club staff. During this research in 2019, only nine of these computers functioned appropriately. Even otherwise functional computers were not updated, or some had distorted monitors. Staff also relied on outdated devices, including a non-commercial home printer to print out all club materials that were not consistently working and an ancient intercom system. Additionally, 15 - club-owned tablets were obtained for specific programs, like E-STEM, that were not used due to the lack of staff support. The club's wireless internet service was often off or did not connect to all devices, including the instructor’s personal computer. Club participants personally lacked access to technology, as they generally did not own personal computers. Many participants at the club only used their school district laptop computers, which had limited access and ability. The participants did not have training on the functionality of their devices, which limited their ability to benefit from the full scope of the technology for projects at the club and to complete schoolwork. Many club participants lacked access to and supported digital technologies in their homes and communities. The co-director said, “The kids use us to help us with their online homework because they do not have access at home, or their parents cannot help them,” during the interview on 12/03/2020. Limited technology access was also an issue for this club and population when an E-STEM class was postponed on 02/15/19 due to the unreliable WIFI connection. Another primary indicator of limited technology access was the inability of many clubs and E-STEM participants to benefit from the online club help once the branch was closed and all club activities moved online. The lack of technology access to stay involved with the club during the Covid-19 pandemic limited most participants
from staying involved with the club during the covid-19 pandemic and getting homework help.

**B. Parental/Guardian Involvement.** Staff members also repeatedly described the role of parents' and guardians’ investment in the club and club curriculums. The participants' interest was not as important as the parents' or guardians’ willingness and interest in their child’s engagement in the E-STEM curriculum. During our interview, the Co-Director stated, “The parents and guardians will be the biggest aspect of finishing the STEM program. They make the difference in if the kids really focus and get back in touch with you.” Parents and guardians also determined participant club time and curriculum participation. For instance, I observed that some parents would wait for the E-STEM class to end before signing their child out on Friday evenings, while others would remove the participant immediately when they came, even if the class were in session. Another way that parental involvement made a difference is the parent being easily accessible to communicate with and stay updated for news regarding the curriculum. Some parents/guardians’ contact numbers provided by the club did not work, which affected their child’s ability to finish the curriculum after the physical club shut down and everything was online.

**C. Staff Human Resources.** Staff identified that the club was understaffed, which was a constant problem overall for club operations and all programs. For example, not having enough staff for the number of participants directly prevented the implementation of the E-STEM curriculum. On certain days I was supposed to teach the E-STEM curriculum because the Club was understaffed, and they needed me to cover general Club participant management. I observed that the club branch does not offer a wage that primarily allows club
staff to focus on club operations, and most staff worked two jobs daily. As the Co-Director stated in our interview, “We are understaffed, most staff have two jobs, so they can’t be here the hours they really need to be to complete all of the programs.”

**Researcher-Identified Challenges**

Through personal observations and experiences as a volunteer and the E-STEM instructor at the BGCA, I identified the lack of culturally-relevant content and mentorship relationships as fundamental challenges for curriculum implementation.

**A. Culturally Relevant Content.** Due to the community conditions and specific circumstances of this BGCA, which included youth of color from poverty with a lack of green space, the participants struggled to connect with the curriculum. Even though the lessons were age-appropriate, the content did not reflect the participants’ lived experiences and environments in terms of the concept level. Participants commonly did not relate nature and E-STEM to their own lives and communities. One 10-year-old Non-E-STEM participant told me, for example, “You have to travel to nature.” Like others, he did not see any nature in his environment and believed that nature and these other subjects were not reflective of his world. In contrast, culturally-relevant content that tied the participants' prior knowledge about the environment to STEM was more effective. For example, one participant's mother told me, “She seems to be enjoying the program; she told me about the recycling lesson and asked if we recycle at home,” highlighting my observation that participants can benefit from the knowledge when they feel as if they can apply what they learn to their own life, and what they have control over, like recycling.
The recycling prompt “It makes me happy when people recycle” was answered in a very different fashion from the prompt “Electric cars help with pollution around Oakland.” Responses to the electric car question lacked nuance, eliciting exceptionally high levels of solid agreement or strong disagreement. Not being as familiar with or understanding the electric car prompted participants to pick the most polarizing choices with little critical thinking. The recycling question brought more variation, with the participants answering from experience, familiarity, and environmental awareness of the benefits of recycling.

B. Mentorship Relationships. Throughout the study, participant interest and overall behavior were strongly affected by their relationship with a parent/guardian, club staff, and me, as the teacher and researcher. The connection between participants and mentor figures generated more engagement in the E-STEM curriculum and behavior in all aspects of their lives.

For example, once I began volunteering as the E-STEM teacher, the club participants frequently asked me about the E-STEM program, persistently inquiring, “Is there STEM today?” My presence and association with the program caused participants to be more interested in the E-STEM curriculum. During our interview, the Co-Director stated, “The kids really have taken to you. It's good that you volunteered and have been consistent with teaching STEM. The kids asked when you were coming back. Thanks for helping out.” I observed that all participants, E-STEM participants or not, were more confident talking during post-surveys because of the relationship we had built up through the year and familiarity with me after re-opening the club after the pandemic shutdown.
Discussion

Corrective justice through an environmental curriculum is necessary to empower disenfranchised populations, especially the youth, by keeping the population aware, connected, and proactive in and with their environment. My results emphasized Bryant and Mohai’s (1992) analysis that racism creates a barrier to resources for low-income communities of color. In my study, the participants and their communities were actively combating poverty. They also needed more technology access and green space. My analysis supports and highlights how structural racism impacts African - American youth from low-income communities. My results contribute to the overall discussion of the intersectionality of environmental racism and the specific ways racism plagues low-income communities of color through environmental inequities, including poor implementation and assessment of environmental curriculum for youth. Sato’s (2013) study examines structural racism experiences in STEM education for children in a community of color. My results differ by finding out how persistent structural racism impacts the youth by accounting for disparities in their environment that kept them disconnected from benefiting from it in their STEM education.

My research began by striving to answer the positive hypothesis that implementing an environmental curriculum in a west Oakland community of youth would inspire pro-environmental actions. My results did not show that the curriculum was influential or specifically beneficial for the participants. Still, the study design was helpful because it empowered the community through engagement, acknowledgment, and consistency. My findings are helpful in that I highlight and describe the lack of technology access, culturally
relevant content, staff human resources, and mentor relationships as emergent themes in this population affecting curriculum retention. Investing in these aspects of the curriculum could benefit the participants more by supporting factors that create resilience in the face of local and global trauma, for participants to stay connected to environmental curriculums and, ultimately, their environment. My results found that all participants benefited by being in this research study, not just those who received the E-STEM curriculum.

My findings on this environmental education curriculum concur with the conclusions of the Committee on Children, Youth, and Families (2016). In both cases, measuring specific corrective justice benefits after implementing an environmental education program reveals that lack of access and resources impacts information retention, even though both environmental education curriculums were designed to mitigate the lack of environmental education in low-income communities. My results agree with Kyburz-Graber et al. (2006) that environmental education had some corrective benefits for the students by at least exposing and aiding them with extra instruction time on environmental justice subjects. Like Larson et al. (2010), I found that measuring factors outside of an environmental curriculum helped understand influences on environmental awareness and attitudes. This could help understand and measure outside factors that improve connectedness to the environment.

My results on parent/guardian involvement importance for participants' engagement in environmental education are consistent with Duvall and Zint (2010). More parental/guardian involvement led to more participant engagement in the environmental curriculum. Similarly, my findings and the findings of Jacobson (2010) aligned by incorporating assessment and implementation issues and adding parent and club staff interviews and
observations to get a more realistic cause and effect of the impact of the environmental education curriculum. There also was the incorporation of the parents and guardians to understand the environmental education curriculum from a community factor perspective. These results, like Losada et al., (2015), agree that making the environmental curriculum more community-based will create a stronger bond between the participants and their environment. This study interviewed the participants, who experienced the environmental education curriculum, and the implementers, including staff and interviewer.

This research had the unique opportunity to assess an E-STEM curriculum for a vulnerable population during an ecological disruption, the Covid-19 pandemic, which exposed emergent themes such as technology access as a barrier to environmental engagement, which may not have initially emerged without it. My findings fit into the current literature of all program implementation and assessments due to the current nature of hybrid program implementation of on-location and remote learning. The results of my study benefit from delving into studies like McPhearson & Tidball (2013), who studied assessing environmental education through and after Hurricane Katrina to children of color from low-income communities. Also, studies by Committee on Children, Youth, and Families (2016) of measuring factors that increase environmental awareness, attitudes, and actions to a disenfranchised youth population strengthen the results of this study and add to the discourse of environmental curriculums and empowerment to communities. My findings address the gap in the literature on environmental curriculum benefits by finding the factors that make the curriculum more accessible for the participants to engage with over time through trauma.
Current studies also conflict with my findings. Because of the stark reality of structural racism impacting my participants, my results contradicted the findings of Kudryavtsev et al., (2012), stating that environmental knowledge would create more pro-environmental behavior. Our studies differed by population, age, and racial demographic. My study also involved children of color, whose age and vulnerability made it more challenging to stay connected outside of the Club, versus the Kudryavtsev et al., (2012) population, whose environmental education assessment was centered around young European adults ages 18-21. Another study’s result that conflicts with my findings was Committee on Children, Youth, and Families (2016), which identified the participants' barriers to accessing the curriculum and not only the outcome. Their study reported no growth with the intervention, but my study results identify the specific reasons why the results did not prove growth from the intervention. More conflicting findings to my findings of environmental curriculum impacting environmental awareness, attitudes, and actions were the results of Larson et al., (2010). Their results stated that their environmental curriculum did impact pro-environmental activities; however, fundamental differences in our studies explain the differing findings, such as the pandemic, which halted and altered the entire process of administering the curriculum and ensuring the results. Due to the trauma of the Covid-19 pandemic, my post-assessment did not allow a comprehensive pre- and post-data comparison. Another difference between our studies is the institution that administered the study and the ethnic makeup of the participants. Their institution was a summer camp where parents paid for environmental education. My study was administered through a non-profit organization, and participation in
the study was voluntary. Their participants were also middle-class youth with more diversity than my studies, mainly African American and black participants.

Gutierrez et al. (2017) study improved technology access and measured if that created more engagement in environmental education. In another study, Galindo-Gonzalez (2008) found that technology access was key for full program implementation and global environmental education. These findings supported the importance of technology access; however, our research differs with population demographic and study design. My research found a constant theme of limited technology access impacting environmental education and assessment, while their studies measured the impact of technology access on an environmental curriculum.

My study design and motivation aligned with this population choice of Djonko-Moore et al., (2018) by explicitly implementing an E-STEM curriculum for a disenfranchised population. However, my findings differed from their study by the number of program implementers and lesson variation. Their study had up to 10 program implementers, and in my research, just me. Overall, because I was a lone implementor, my research was limited. Mainly our study results differed in final levels of information retention from the participants because their study did have a specialized curriculum, and their participants did gain more from the actual curriculum than my participants. Their lessons and curriculum were more interactive, including a field trip, and more funded.

Like Mcphearson and Tidball (2013), my research was a case study focused on implementing and assessing an environmental education curriculum for children of color from a low-income community during an ecological disturbance. However, our research
differs from the type of ecological disturbance that occurred. Their studies’ environmental education curriculum was affected by the natural disaster of a hurricane, which altered their physical environment. My studies environmental education curriculum was affected by a biomedical disturbance, the Covid-19 pandemic, and changed the participants' social environment. According to McPhearson and Tidball (2013), after the disruption, the community engaged in environmental stewardship, such as planting trees and community clean-up initiatives after the disturbance, to express agency and positive environmental awareness, attitudes, and actions in their communities. The participants from my study did not react similarly to their ecological disturbance. They did the opposite by being less engaged socially and with nature. I believe that because the disruption in my study was more social and less physical, participants did not see the need to adapt and react in the same way, nor feel they had reason or power to respond. My results add to the discussion of local identities and traditions of a disenfranchised population responding to and understanding trauma and how that understanding affects environmental interaction like the study of Bullard & Wright (2009) after Hurricane Katrina.

This study had many unexpected findings due to the global covid-19 pandemic. The pandemic caused club closures that affected every aspect of the study design, specifically data collection. The club closing affected curriculum implementation by not allowing me to finish teaching the modules and curriculum. It also affected the post-data supply because keeping in touch with participants was challenging and made managing data collection harder. Due to the severity of the covid-19 pandemic shutdown, the whole study design had to be re-written from measuring the participants' curriculum growth to measuring and
accounting for factors that account for the participants' resilience and ability to stay connected to the curriculum and their environment throughout local and global traumas. Another unexpected finding was the lack of resources that the club had to endure. The club did not have adequate technology and a system to stay in contact with the kids affected post data collection and overall club operations that the participants relied on for their day-to-day lifestyle.

This study's limitations were a global pandemic, a lack of access to technology, one researcher, and a vulnerable population. One major study limitation was the impact of the Covid-19 pandemic closing the branch, negatively impacting data collection. The pandemic caused a Club shutdown, which halted the actual curriculum classes and stagnated and shortened post-data collection. Another major limitation was the number of researchers for such a vast project. There was only one researcher, which limited the amount of data collected over time. The population's vulnerability turned out to be a limiting research factor because contacting parents and guardians of participants for further assessment was complicated and had many inconsistencies. Other limitations included poor technological access and staff human resources. Not having adequate technology access negatively impacted the ability to teach the curriculum and participants and families being able to reconnect to the curriculum and study throughout the pandemic. Having enough staff human resources negatively impacted the curriculum and study design by not collecting as much data as a study could with multiple researchers having individual tasks.

The importance of my findings explains the complexities of connecting children of color from low-income communities to their environment and pro-environmental actions, even
with a designated environmental curriculum implemented to foster that relationship. My results imply that when teaching a vulnerable youth population, the content needs to be culturally relevant and relatable to see information retention, positive attitudes, and growth in pro-environmental behavior. Although the curriculum is essential, my results state that fostering positive relationships with adults is equally important, which creates comfort and a sense of community for the participants. These results add to the gap in the literature on environmental racism impacting environmental awareness, attitudes, and actions and which factors make populations resilient to trauma in their environments. This research also helps prioritize how resources and funding are allocated when implementing environmental education to a vulnerable population by identifying emergent themes and critical factors.

From the findings of my study, I recommend a practical application to have educational institutions such as the SeaResearch Foundation, Inc., and targeted communities like the Leonard J. Metzler BGCA to co-create environmental curriculums specific to their youth. Another recommendation from these results would be for the academic institutions that create the content to provide the technology throughout the curriculum and a tech liaison to help the communities understand and use the technology. Another practical suggestion from this data would be for community organizations, such as the BGCA, to hire specific personnel to teach the curriculum.

More practical suggestions from my results include actively encouraging positive mentor relationships by engaging parents and guardians of the participants so the curriculum might have higher success rates. Also, community environmental education events for the whole family will have a more long-lasting impact on the participants. My study results recommend
that donors can benefit underserved communities and their institutions by pinpointing exactly
where to allocate the funds. My results also help donors and funding from franchises like the
Warriors by letting them know to have periodic equipment checks on donated materials for
the best use of money.

Future work that could build on my results would include community environmental
curriculums through non-profit organizations and community projects partnership. Studying
fundamental family dynamics was a limitation that occurred in my results and needs further
research to add to the literature on impactful factors on environmental awareness, attitudes,
and actions. Future studies could also build off my results and analysis by adding more
researchers to the design to encourage positive mentor relationships to keep participants
interested in the curriculum and foster a higher sense of community. Also, other researchers
can use this research and results to focus on studying how academic institutions develop
curriculum and how they can be curtailed for more culturally relevant content and realistic
goals for disenfranchised communities. Potential areas for future research from my results
should also include studying trauma and how staying connected to the environment could
foster community involvement and healing.
Conclusion

The critical points of this research were finding emergent themes that impacted all participants' environmental awareness, attitudes, and actions that were more influential than the actual curriculum. The emergent themes included parental and guardian involvement, mentor relationships, culturally relevant content, limited human staff resources, and technology access. The results concluded that environmental awareness, attitudes, and actions are impacted and influenced by more than the intervention of the E-STEM curriculum. Those influential emergent themes are imperative to report when measuring the growth of pro-environmental activities of the participants.

Other critical aspects of this research include understanding the connection between participants' resilience to the primary and secondary traumas of environmental racism and global traumas to continue to create pro-environmental actions. For the goal of corrective justice, these results help focus on how resources can be directed productively to benefit the intended population. These results are essential to the broader understanding of combating environmental injustices because they deal with the global challenges that all communities face and precisely how to empower already disenfranchised communities during and after traumas. Understanding the factors that keep vulnerable youth connected to their environment and their environmental education curriculum throughout an ecological and societal disturbance could be beneficial to strengthen all program implementation in oppressed communities. These results could help disenfranchised youth empower their environment and stay connected to nature.
Future direction in environmental education curriculums and assessments must consider broad and community challenges outside the curriculum to achieve its goals. It is critical to have a detailed supportive approach by understanding which factors influence disenfranchised youth, keeping them interested through traumas to create resilience and healing, and experiencing their environment in the highest, safest capacity.
Recommendations

Curriculum creators and community organizations should co-create curriculums:

- Local environmental justice groups should partner with the BGCA for community days.
- Organizational leaders (ex., Boys and Girls Club Director) should have input in E-STEM curriculum development and content.
- The curriculum should incorporate specific local environmental content for participants to understand environmental justice issues.

Curriculum creators should fund curriculum needs:

- BGCA and curriculum creators should hire a specific curriculum implementor.
- Field trips should be funded by the curriculum creators and included as mandatory lessons.
- Curriculum creators should provide technology equipment (ex. SeaReserch Foundation, Inc.)
- The BGCA and curriculum creators should hire personal technology liaisons for specific curriculums.
- The curriculum creators should have periodic equipment checks.

The curriculum creators should create community-inspired environmental education curriculums, including, family programs and events:

- The programs should include volunteer opportunities for the local community to get involved with the E-STEM curriculum.
• The programs should include local environmental justice groups hosting events for BGCA participants.

• The programs should include local field trips to teach and improve environmental justice issues. (ex. Park clean-up)
References


(Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 93–116). MIT Press.


APPENDIX A

2019 Research Recruitment Speech Script

You are invited to participate in a research study. The research team is doing a project to analyze how a S.T.E.M curriculum impacts environmental awareness, attitudes, and actions. We want to learn from your experience as participants. We want to ask you to participate in this project in order to measure the effectiveness of the program in helping program participants like you to be more prepared to understand their environment and environmental attitudes.

What is required to participate in the research project is:

1. Fill out two surveys, one at the start of the program or another when the program ends.
2. Participate in an interview with the researcher facilitator about their environmental awareness, attitudes, and actions and S.T.E.M concepts.
   
   * This project will contribute to knowledge about how to support low-income and African American/Black communities to encourage S.T.E.M understanding.

   * This project will help us to improve the program that the Boys and Girls club accepts and implements for the next years.

The risks that may have participate are:

- The overall 1-hour temporary discomfort for the participants to complete the pre and post-survey and interview.

I want to stress that your participation or lack of participation in this project will by NO MEANS impact your ability to participate in the tutoring sessions or S.T.E.M program, nor
will it impact any relationship you have with the program instructor, the Boys, and Girls
Club organization, or Boys and Girls Club staff.
APPENDIX B

Parental/Guardian Consent Form

PARENTAL PERMISSION FORM FOR CHILD’S RESEARCH PARTICIPATION

Study Title:

The relationship between participation in a web-infused S.T.E.M curriculum and environmental awareness, attitudes, and actions among 7–12-year-olds in a low-income community of color.

Principal Investigator:

Dr. Rachel O’Malley

Student Researcher:

Ashari Taylor-Watson

IRB Study Number: [this is the protocol number that is assigned to your study in the AURA software system]**

Your child is being asked to take part in a research study. This form has important information about the reason for doing this study, what we will ask your child to do, and the way we would like to use information about your child if you choose to allow your child to be in the study.

Why are you doing this study?

Your child is being asked to participate in a research study about the STEM class they are enrolled in.

The purpose of the study is to measure the program’s objectives and effects of the program on the student’s environmental awareness, attitudes, and actions.

What will my child be asked to do if my child is in this study?
Your child will be asked to complete two online surveys and an interview asking questions about environmental awareness, attitudes, and actions. Personal questions will be asked about their neighborhood's environmental good and bads. Participation should take about 30 minutes.

I would like to audio tape your child as he/she performs the interview aspect of the assessment. Interview questions will be recorded to make sure that I remember all the information accurately. The researchers will keep these tapes secured by passcode I-phone and the researcher will only use them. The researcher will only have access to the recordings. We will only audio tape your child if you and your child give us permission.

You may opt out of this audio recording at the bottom of this form.

**What are the possible risks or discomforts to my child?**

To the best of our knowledge, the things your child would be doing in this study have no more risk of harm than the risks of everyday life. Your child’s participation in this study does not involve any physical or emotional risk to your child.

Your child’s participation in this study may involve the following inconveniences:

• Your child may get tired during the tasks. Your child can rest/take a break at any time.

• Your child may feel emotional or upset when answering some of the questions. Your child can tell the interviewer at any time if he/she wants to take a break or stop the interview.

• Your child may be uncomfortable with some of the questions and topics we will ask about. If your child is uncomfortable, they are free to not answer or skip to the next question.
As with all research, there is a chance that confidentiality of the information we collect about your child could be breached – we will take steps to minimize this risk, as discussed in more detail below in this form.

Your child’s participation in the S.T.E.M curriculum will not be affected if you choose to not participate in the study or if you choose to stop participating at any point. They will not miss any instructional program time by opting out or any of the rest of the branch activities.

**What are the possible benefits for my child or others?**

Your child is not likely to have any direct benefit from being in this research study. This study is designed to learn more about the program and participants' ideals about their awareness, attitudes, and actions towards their environment. The study results may be used to help other people in the future.

Taking part in this research study may not benefit your child personally, but we may learn new things that will help others.

The possible benefits to your child from this study include a better understanding of the purpose of completing a S.T.E.M program and the benefits of being exposed to these fields.

**How will you protect the information you collect about my child, and how will that information be shared?**

Results of this study may be used in publications and presentations. There will be no naming of students by name or sharing of personal information. Even answers that include specific answers that are personal will not be used. All of the information will be stored in password protected devices only accessible to the researcher.
We will not ask about child abuse or neglect, but if your child tells us about child abuse or neglect, we will report that information to the appropriate authorities.

**Financial Information**

Participation in this study will involve no cost to you or your child. Your child will not be paid for participating in this study.

**What are my child’s rights as a research participant?**

Participation in this study is voluntary. Your child may withdraw from this study at any time -- you and your child will not be penalized in any way or lose any sort of benefits for deciding to stop participation. If you and your child decide not to be in this study, this will not affect the relationship you and your child have with your child’s program participation in any way.

If your child decides to withdraw from this study, the researchers will ask if the information already collected from your child can be used, or in the alternative, the information already collected will not be used.

**Who can I contact if I have questions or concerns about this research study?**

If you or your child have any questions, you may contact the researchers at Ashari Taylor-Watson.

757-903-3303

Ashari.taylor-watson@sjsu.edu

If you have any questions about your child’s rights as a participant in this research, you can contact the following office at San Jose State University.

Institutional Review Board
San Jose State University
Parental Permission for Child’s Participation in Research

I have read this form and the research study has been explained to me. I have been given the opportunity to ask questions and my questions have been answered. If I have additional questions, I have been told whom to contact. I give permission for my child to participate in the research study described above and will receive a copy of this Parental Permission form after I sign it.

Consent to Quote from Interview

I may wish to quote from the interview with your child either in the presentations or articles resulting from this work. A pseudonym (fake name) will be used in order to protect your child’s identity.

Initial one of the following to indicate your choice:

_____ (initial) I agree for the researcher to use direct quotes from my child’s interview.

_____ (initial) I do not agree for the researcher to use direct quotes from my child’s interview.

Consent to Audio-Record Interview

The initial one of the following to indicate your choice:

_____ (initial) I agree for the research interview to be audio recorded, solely for research purposes.

_____ (initial) I do not agree for the research interview to be audio recorded, solely for research purposes.
<table>
<thead>
<tr>
<th>Parent/Legal Guardian’s Name (printed) and Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashari Taylor-Watson</td>
<td>05/12/19</td>
</tr>
</tbody>
</table>
APPENDIX C

Assent Form

I am from San Jose State University, and I am asking you to be in a research study. We do research studies to learn more about how the world works and why people act the way they do. In this study, we want to learn about the relationship between the Web-Infused S.T.E.M program and environmental awareness, attitudes, and actions.

What we are asking you to do:

We would like to ask you to take 2 online surveys and participate in one interview. It will take 20 minutes for the survey and 10 minutes for the interviews. On the survey, you can skip any question if it makes you uncomfortable.

Do I have to be in this study?

You do not have to participate in this study. It is up to you. You can say no now, or you can even change your mind later. No one will be upset with you if you decide not to be in this study.

Your participation in the S.T.E.M will not be affected if you choose to not participate in the study or if you choose to stop participating at any point. You will not miss any instructional program time by opting out.

Will being in this study hurt or help me in any way?

Being in this study will bring you no harm. There are no direct benefits to you for participating in this study. It will hopefully help us learn more about the impact of the program and the environment.

What will you do with information about me?
We will be very careful to keep your answers to the survey and answers private. Before and after the study we will keep all information we collect about you locked up and password protected.

If you want to stop doing the study, contact Ashari Taylor-Watson, or Courtney “CoCo” at any time. If you choose to stop before we are finished, any answers you already gave will be destroyed. There is no penalty for stopping.

**If you have questions about the study, contact:**

Ashari Taylor- Watson

**If you have questions about your rights in the study, contact:**

Institutional Review Board

San Jose State University

Phone number: (408) 924-2479

Email address: irb@sjsu.edu

**Agreement:**

By signing this form, I agree to be in the research study described above.

Name: ________________________________

Signature: ________________________________ Date: _____________

You will receive a copy of this form.
APPENDIX D

Survey/Interview Questions

Default Question Block

**STEM Class**

- [ ] Yes
- [ ] No

**Age**

- [ ] 6
- [ ] 7
- [ ] 8
- [ ] 9
- [ ] 10
- [ ] 11
- [ ] 1
- [ ] 2
- [ ] 3
Gender

☐ Boy
☐ Girl
☐ Other

Awareness
What is this type of energy machine called?

- Wind Turbine
- Solar Panel
- Water Dam
Water Turbine

Anemometer
What does Geo mean?

- Energy
- Wind
- Earth
- Sun
- Water
Where does fresh water come from?

- Earth's Surface
- Under the ground
- The sky
What animal is NOT endangered?

- Snakes
- Elephants
- Butterflies
- Sea Turtles
Which is NOT a way to save energy?

- Recycle
- Take shorter showers
- Cut the lights off when leaving a room
- Unplug chargers when not being used

Let the water run when brushing your teeth
What type of machine is this called?

- Water Turbine
- Water dam
- Electric Car
- Wind
- Turbine
- Solar Panel

Which one of these is not part of the water cycle?
What do Engineers do?

- Solve problems
Build things

Travel

Fly to space

Teach classes

attitude

How much do you agree with this statement:

I would ride my bike instead of riding in a car to help pollution.
How much do you agree with this statement:

Celebrities should tell people to keep the environment clean.
How much do you agree with this statement:

Electric cars are important to help with pollution around Oakland.
How much do you agree with this statement:

It makes me happy when people recycle.
How much do you agree with this statement:

I make sure I throw my trash away.
How much do you agree with this statement:

To save water, I would turn the sink off while I'm brushing my teeth.
How much do you agree with this statement:
I have asked my family and friends to recycle so they won't hurt the environment.
How much do you agree with this statement:

I would spend a Saturday picking up trash to help clean the environment.
I would talk to community leaders about cleaning up our neighborhood.

Block 6

What does S.T.E.M mean?
- Science Technology Engineering and Math
- Science Time Earth and Mars
Soil Tape Energy and Math
Sun Tape Engineer Math
Soil Time Energy and Mars
Qualitative Questions

What is nature? Is it important? Why or why not?

Can you tell me an example about where nature and technology come together?

Powered by Qualtrics

Interview Guide for staff:

What is your position at the Boys and Girls club and how long have you been here?

Could you tell me about the overall demographic of the students at this specific Boys and Girls Club?
What do you believe the benefits are for implementing the S.T.E.M program at this particular branch?

What are the challenges of implementing the S.T.E.M program?

What programs would you like to see at the Boys and Girls Club?

What are some overall improvements you would like to see at the Boys and Girls Club?

Anything else you would like to add that I didn’t ask about the S.T.E.M program?