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Education for Sustainability: The Effectiveness of a Place Based Environmental Education Unit in Food Waste Reduction on the Environmental Awareness of Fourth Grade Students

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EDUCATION FOR SUSTAINABILITY: THE EFFECTIVENESS OF A PLACE BASED ENVIRONMENTAL EDUCATION UNIT IN FOOD WASTE REDUCTION ON THE ENVIRONMENTAL AWARENESS OF FOURTH GRADE STUDENTS

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DEDICATION

To my family, Mom, Dad, and sister, Maura, who helped create a home that supported ecoliteracy before it was "cool." Whether it was the countless pets housed in my bedroom, the practice of feeding kitchen scraps to the chickens, or the frequent requests to "go out and play," your loving efforts helped make me the person I am today!

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ABSTRACT

Implementation of a place-based composting unit for food reduction in the Spring of 2019 with 10 fourth-grade students utilized qualitative methodologies in order to measure its effects on environmental awareness in the individuals. Guided by Capra's (1997) notion of sustainability in an ecoliterate society and Sobel's (2008) place-based pedagogy, the curriculum and instructional decisions during the construction of the unit utilized read alouds and outdoor activities that aimed to increase the students' connectedness to their local setting in order to motivate students for engagement in ecoliterate behaviors. Pre- and post-intervention surveys, artifacts and exit slips in student nature journals, teacher-researcher field notes, and formal interviews each developed rich data which were first examined individually. From these independent data analyses, three themes then emerged that holistically captured the overall findings of the study; (a) students developed a heightened level of connectedness to nature, (b) an increase in sense of empowerment, and (c) expressed an overall value of ecoliteracy in school settings. Results from this action research suggests a place based environmental education approach has a positive effect in fostering environmental awareness of fourth grade students. The results of the study also suggest that ecoliteracy, as both a framework for sustainable practices and character development, should further be explored because of its effects on empowering students for positive change and actively engaging students in class activities.

Keywords: place-based pedagogy, ecoliterate, ecoliteracy, sustainability, composting

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LIST OF ABBREVIATIONS

EE.....Environmental Education

PLC ..... Professional Learning Community

SDT ..... Self-Determination Theory

STEM ..... Science, Technology, Engineering, and Math

CHAPTER ONE

INTRODUCTION

Earth's ecological systems provide countless benefits to our society, such as water filtration, soil stabilization, and energy flow, but adding humans into the matrix often complicates things. It is widely agreed that humans either indirectly or directly alter all ecosystems on Earth because of our actions (Rossnerova et al., 2017; Wyles, Pahl, & Thompson, 2014). New research feeds heavily into this debate as scientists have recently reported that nature "untouched by humans" is now almost entirely gone (Mooney & Dennis, 2016; Dayton & Sala, 2001). With human activities now exerting increasingly aggressive changes to the environment that overpower those of natural processes, Paul Crutzen (2006), the atmospheric chemist and Noble laureate, deemed it necessary to label a new geologic epoch as the "Anthropocene," characterized by widespread and geologically detectable human impact on the planet (Caradonna, 2014; Crutzen, 2006; Stronmberg, 2013).

Although there are many topics to consider when analyzing environmental impacts, one receiving increasing attention is food waste because of its complexity in implications across contexts. Food waste, according to the EPA, can be defined as the food that was not utilized for its intended purpose. For this action research study, the EPA's (2018) overarching term "wasted food" will be used instead of "food waste" for food that was not used for its intended purposes, because it conveys that a valuable resource was being wasted, rather than using "food waste," which implies that it was food

that no longer had value. Many have concluded that between 30- 40% of our food supply becomes waste (Buzby, Wells, & Hyman, 2014; USDA, 2014). Not only does this unnecessary wasted food take up valuable space in landfills, but also scientists have further reported the implications it has on our atmospheric conditions.

When organic materials go to the landfill, it has the same effects as tying it up in a plastic bag. Not only does it have negative effects on the atmosphere, but also valuable nutrients are wasted as they become entrapped inside a garbage filled time capsule. Municipal solid waste (MSW) landfills, containing all the everyday items we use and throw away from our homes, schools, and business, are the third-largest source of human-related methane emissions in the United States, accounting for approximately 14.1% of these emissions in 2016 (EPA, 2016). Specifically, when the MSW is first deposited in a landfill, it undergoes an aerobic (with oxygen) decomposition stage where little methane is generated. Within a year in the landfill, anaerobic conditions are established, and methane-producing bacteria begin to decompose the waste and generate methane (EPA, n.d.). These conditions in the landfills result in global greenhouse gas emissions called methane gas, a potent material 28 to 36 times more effective than CO_2 at trapping heat in the atmosphere over a 100-year period (EPA, n.d.; Fleurbaey et al., 2014).

By cutting down on wasted food, as much as 70 billion tons of greenhouse gases could be prevented from being released into the atmosphere, resulting in one of the greatest possibilities for individuals, companies, and communities to reverse global warming in today's society (Frischmann, 2018). Furthermore, when food becomes trapped in landfills, the nutrients from these substances never return to the soil, leaving a

void in the environmental nitrogen and phosphorus cycles, which are required for future crop growth.

Although many have acknowledged our biosphere's ecological limitations and have called for conservation effects, Martin, Maris, and Simberloff (2016) argued that shifts in societal values must be made. In 2015 alone, more than 39 million tons of wasted food was created, with only 5.3 percent diverted from landfills for composting (EPA, 2018). It was further argued that respecting these limits directly conflicts with an economy centered on growth and technology (Marin, Maris & Simberloff, 2016).

Others concluded that sudden outbursts of public policies for a 'greener' industry will not be enough; unless it is also coupled with sustainability practices in individual households, positive impacts to the environment will be slow moving (Christensen, 1997; Taylor & Allen, 2007). That is why educational institutions, not bogged down by the pressures of economic stability and highly influential in its role of enlightenment in our nations' children, must select a more holistic approach to child development that includes environmental education (EE) and sustainability concepts.

While many postulate that the goal of the educational institution is to equip students with the necessary skills to ensure future success for the individual and the stability of a nation, historical debates continue without resolve as pedagogues and politicians debate what this looks like in the 21st century classroom. John Dewey (1938) tried to mend the epistemological divide by remarking during a lecture for an educator audience that he possessed the "firm belief that the fundamental issue is not of new versus old education, nor of progressive against traditional education but a question of what must be to be worthy of the name education" (as cited by Jackson, 2012, p. 4).

Although it sounds simplistic, when trying to articulate the goal of education, it becomes divided along historical and civilization spectrums (Kayode, 2016).

Kayode (2016) further concluded after a meta-analysis of the arguments and opinions of past education philosophers and scholars that the goal of education essentially has always kept human development as the nucleus. Schools should be a place where students develop their minds but society's pressures exist to transform this achievement into an unobtainable quantitative measurement (Holt, 2005). Holt (2005) went on further to conclude, "This 'curriculum straitjacket' is the price exacted for believing that education is about assessed performance on specified content" (p. 57). This is conclusive practices with most Western schools that follow what Paulo Freire (1968) called the "banking model," which means "the teacher issues communiques and makes deposits which the students patiently receive, memorize, and repeat" (p. 72).

Although current political pressures have focused on measurable human cognitive development based on accountability measures on standardized testing, others have looked at a broader view of this concept. Knowledge is believed to be something that is not just stored and talked about, but something to be lived (Margolin, 2005; Reich, 2007). EE was introduced into public education to help students gain knowledge and skills that help them make sound decisions as it bridges the gap between their education and their own neighborhoods and communities (Carter & Simmons, 2010). Disinger (1985) identified three antecedents to EE: nature study, conservation education, and outdoor education. As a teaching method, Carter and Simmons (2010) concluded that quality EE "emphasizes the best of what current pedagogical knowledge has to offer and guides the pursuit of hands-on, minds-on learning toward the development of an environmentally

literate citizenry" (p. 14). When Orr (1994) called for reconstruction of the entire education system as a necessity for all students to obtain proficiencies in environmental consciousness skills, he developed a broader humanitarian view on education. Orr (1992) originated the phrase "ecological literacy," thus further advancing the idea of literacy in the school setting to include the emphasis on the creation of sustainable human communities. Capra (1997), guided by the Orr's ideologies, later coined the term ecoliteracy to name the understanding one has of the organization of ecosystems and the application of principles for sustainability in society (McBride, Brewer, Berkowitz, & Borrie, 2013; Wooltorton, 2006).

Although there are high degrees of similarities between EE, environmental literacy, and ecoliteracy in regards to affective, knowledge, cognitive skills, and behavioral components, this action research will narrow the focus to looking at student's self-awareness within the concept of ecoliteracy because of its clear emphasis on sustainability (McBride et al., 2013). McBride et al. (2013) defined an ecoliterate person as someone "prepared to be an effective member of sustainable society, with well-rounded abilities of head, heart, hands, and spirit" and one "comprising an organic understanding of the world and the participatory action within and with the environment" (p. 14).

Because a correlation exists between one's own environmental awareness and environmentally friendly actions (Fraj & Martinez, 2007; Kaiser & Shimoda, 1999; Tilikidou, 2007), awareness must be explored and measured within the context of the local setting. Awareness in an individual is a complex construct, including many different cognitive and affective components. When added to the context of the environment,

Yilmaz and Taş (2018) explained how these two domains coexist: "while the cognitive component of awareness provides agglomeration of the knowledge on the environment, the affective component provides a sensitive approach to all living and nonliving beings in the world" (p. 1928).

For this study, environmental awareness was defined with both concepts in mind. These cognitive and affective factors are essential in holistically viewed EE (Iozzi, 1989). Yet, historically speaking, science teaching often falls short in developing curriculum with a focus on the affective domain. This may be attributing to the lack of environmental awareness in our youth, which is a serious obstacle for effective education and environmental culture development. Because traditional teaching methods have been shown to be insufficient in shaping proactive attitudes towards assessing and solving environmental problems (Nazarenko & Kolesnik, 2018), new holistic curriculum and instruction development within the context of environmental awareness and ecoliteracy should be explored in order to develop a more sustainable future.

Statement of the Problem of Practice

The school of study, Southeast Elementary School (pseudonym), adopted a comprehensive learning model through student leadership development in 2013. This whole-school model includes fostering student's self-esteem, disciplines, responsibility, confidence, and creativity. This includes providing leadership opportunities where students are given opportunities to take ownership in the school community, such as becoming a hall monitor, morning announcer, or part of the recycling crew, and provides mentoring opportunities between the lower and upper elementary school students. All students in pre-K to fifth grade also come to the STEM Lab during a six-day related arts

rotation with P.E., Art, Music, and Library. Students during this time are exposed to a variety of activities, such as conducting various experiments, collaboratively engaging in engineering challenges, coding in robotics, and gardening in the school garden, to help support learning in their homeroom classrooms.

However, it is lacking in ecoliteracy units of instruction. Opportunities for ecoliterate leadership appear to exist outside of the school walls. For instance, recent pro-environmental initiatives have looked to move the community toward a more sustainable way of living as it looks to combat environmental issues threatening the local environment. Specifically, the school's proximity to the coastline has caused many locals to act on the negative human impacts pertaining to plastics in the ocean. A new county ordinance effective November 1, 2018 banned plastic bags in local businesses. Furthermore, a parent of two students from this school ignited *A #StrawlessSummer* campaign, in which over fifty restaurants in the nearby tourist town eliminated the use of plastic straws between the months of July through September 2018 to combat the threat it has to the ecosystem. These community initiatives look promising for development of ecoliteracy of the youth at Southeast Elementary.

Yet, watching students during the lunchroom would tell a different story. Current practices are contributing to the annual 133 billion pounds and $160 billion food waste epidemic (NRDC, 2017; USDA, n.d.). Reports suggest that 30-40% of the United States' food supply becomes food waste (USDA, n.d.). This appears to be consistent with observations at the school. For example, students at the local level are often seen throwing away untouched food because they didn't feel like eating it, such as unopened

containers of milk and whole apples. Also, some students appear to have a disconnect with resources, efforts, and time needed to develop these materials.

On occasion, students across grade levels might tear up a plastic cup or break writing utensils in the lab resulting in them having to be thrown away instead of reused. These are often not students that overtly try to get into trouble. This might signal an intrinsic disconnect between the child's action and the overall global waste issue. Also, recent changes to the county's recycling program have further complicated matters as they no longer collect anything except paper and cardboard materials.

The Southeast Elementary campus provides a unique setting for learning because it contains both an outdoor classroom, located in the woods in between the school building and the playground, and a small garden of 16 raised beds. These settings should be embraced for their ability to bring Life Science standards to life. Yet, teachers do not take their students outside to these areas. Also, student observations in the upper elementary conclude that, overall, students do not like to go outside anyway. When provided a choice in the STEM Lab, students will consistently choose to stay inside for a lesson instead of going outside because it is "too hot," "too many bugs," or "it's just boring."

Upon careful evaluation of current practices, opportunities for environmental stewardship could be improved as school climate still highly emphasizes standards-driven curriculum. Because such stress is based on covering standards, teachers at the local level have explained that they do not deviate from the intended indicators when making science curriculum and instruction decisions. Because only 5% of current indicators focus

on EE and sustainability principles, it can be concluded that many students are not being exposed to ecoliteracy in the classroom.

Table 1.1

State Indicators Focused on Environmental Education and Sustainability Principles

Grade Level	*Number of Performance Indicators in Science According to State Website*	*Number of Performance Indicators with Focus on Environmental Education and Sustainability*	*Specifics Regarding the State Indicator (with Focus on Environmental Education and Sustainability)*
K	13	0	N/A
1st	19	1	1.E.4B.2 Obtain and communicate information to explain ways natural resources can be conserved (such as reducing trash through reuse, recycling, or replanting trees)
2nd	23	0	N/A
3rd	22	2	3.E.4B.3 Obtain and communicate information to explain how natural events (such as fires, landslides, earthquakes, volcanic eruptions, or floods) and human activities (such as farming, mining, or building) impact the environment. 3.E.4B.4 Define problems caused by a natural event or human activity and design devices or solutions to reduce the impact on the environment.
4th	27	0	N/A
5th	24	3	5.E.3B.3 Construct scientific arguments to support claims that human activities (such as conservation efforts or pollution) affect the land and oceans of Earth. 5.E.3B.4 Define problems caused by natural processes or human activities and test possible solutions to reduce the impact on landforms and the ocean shore zone.
Total	***128***	***6***	***5% of current indicators contains elements of Environmental Education and Sustainability.***

Five years ago, one hour was devoted to Science each day for all students. Because of the district mandates for more Language Arts and Math time, students in their homerooms now only receive Science instruction for 40 minutes a day on a bi-weekly schedule so that the small block can be shared with Social Studies. Specifically, teachers at Southeast Elementary went from 600 minutes to 200 minutes every two weeks. Although the time was cut to a third of the original allotment, the number of standards

required to be taught remain the same. Some may argue that as time has drastically been reduced, the rigor and depth in these standards have increased as pressures continue to grow to improve our global rankings in Math and Sciences (Windschitl & Barton, 2016).

This issue follows national trends. The National Science Teachers Association reported that 45% of elementary teachers have recently stated they have seen a decrease in their overall Science time (Petrinjak, 2011). With nearly 40% of teachers in another study reporting that they have only 60 minutes or less allotted to them each week to teach science skills (Lawrence Hall of Science Press Release, 2011), there is clearly an alarming trend. The literature suggests that two factors, the large amount of materials needed to be covered in limited amount of time and high pressures teachers experience to teach to a standardized test, make educators more likely to teach complex learning materials in a shallow way of drill and practice (Zohar & Agmon, 2018). These time restraints make it difficult to accomplish all goals in education if not looked at through a multifaceted lens.

Many leaders in EE characterize a successful program as one that is interdisciplinary, with the unifying theme of studying the relationship between people and their environment (Burgess, 2010). With an interdisciplinary approach to learning, the contexts "fosters the development of certain cognitive abilities such as perspective taking and thinking critically about conflicting information on an issue or problem from multiple knowledge sources" (Repko, Szostak, & Phillips Buchberger, 2017, p. xxii). One very popular approach to interdisciplinary units, or integrated science, is STEM (Science, Technology, Engineering, & Math), which focuses on Dewey's (1938) call for

"sound philosophy of experience" (p.91) without the manacles of time in a traditional classroom schedule.

In conclusion, ecoilliterate behaviors at the local level signal deficiencies in current curriculum toward sustainability and outdoor experiences. This, coupled with teachers' concern over insufficient content time, has led this teacher-researcher to explore interdisciplinary curriculum development to combat current local problems. Being both the STEM Lab teacher and committee chair, this researcher has both the freedom and responsibility to engage in innovative new ways to teach and evaluate epistemologies pertaining to science and ecoliteracy development in the students in the hopes of effecting future schoolwide changes. Schwägerl (2014) concluded that the succession of technical, social and economic innovations has allowed people to both positively and negatively transform Earth in a mere two hundred years, spreading themselves and their accomplishments across almost the entire planet. These same advancements have also provided the human species with more environmental awareness. As society works to right the wrongs created in the past, schools must look to empower the next generation of individuals. Gayford (2009) explained that the link between sustainability lesson objectives and motivation for action when he concluded, "Pessimism can turn to hope when young people are given knowledge about how to act, and when what might be described as 'unfocused fear' is replaced by factual information and practical strategies for addressing issues" (p. 3).

As educators look to do this, it is important to create curriculum that is centered around solution-based learning, a foundation of sustainability education, which provides opportunities to expand the traditional curriculum into the real world for real change for

the betterment of the environment and its society (Eflin & Sheaffer, 2006). Yet, what does ecoliteracy, the integration of emotional, social, and ecological intelligences (Goleman, Bennett, & Barlow, 2013), look like at the local level? What are student perceptions of lessons designed for ecoliteracy and how can units be integrated seamlessly into standards-driven educational systems? These questions guide the development of the theoretical and conceptual frameworks of this action research study.

Upon continuing evaluation of school practices, it was also concluded that garden practices where further contributing to a bigger 'carbon footprint' as compost materials had to be purchased and transported to the school from local business and plastic packaging eventually thrown away. Although fourth grade students do not have EE and sustainability principles embedded in their standards, this action research will look to create a place-based unit of composting as a way to reduce cafeteria waste and naturally support the school garden practices. While utilizing qualitative research methods, both student and teacher perspectives were studied for practicality of implementation of sustainable ideologies across units and the effects it has on the participants. Dr. Jane Goodall explained the importance of the local setting by stating that "People say think globally, act locally. Well, if you think globally, it is overwhelming, and you do not have enough energy left to act locally. Just act locally and see what a difference you can make" (as cited in Christ, 2015, para. 2). With Goodall as inspiration, this action research study, grounded in the constructivism and social learning theories of learners, sought a better understanding of classroom practices that affect students' environmental consciousness in the local setting.

Research Question

What impact will a place-based environmental education approach have on the environmental awareness level of 10 fourth grade students in a school located in a southeastern state?

Purpose of the Study

The purpose of this study is to examine the impact that a place-based environmental education approach will have on the environmental awareness level of 10 fourth grade students in a school located in a southeastern state.

**Place-based EE is broadly defined as the process of using the local community and environment as a starting point to teach concepts through exposure to hand-on, real world learning experiences across the curriculum (See Literature Review p. 41 for more information).*

Theoretical Framework

To strengthen the quality criteria, the theoretical frameworks that guide this study must first be explained. Grant and Osanloo (2014) placed greater value on first selecting theories that reflect your values and understandings of the world around you. Once this "foundation" is selected, the theoretical framework becomes the base in which all other aspects of the dissertation are built. Because theoretical frameworks derive from theories that have "been tested and validated", it becomes the anchor to the rest of the work and strengthens the dissertation arguments (Grant & Osanloo, 2014, p. 16). The theory becomes the lens in which all concepts are viewed through.

Both a strong understanding of the theoretical frameworks and a detailed description of the context of the study are needed to improve the rigor into the

dissertation framework (Durdella, 2018). Action researchers are interested in generating knowledge from a study that is valid and trustworthy (Herr & Anderson, 2015). It is situational, practical, and cyclical in a way that requires the action researcher to carefully consider their unique context and participants in their constant quest of knowledge to improve their teaching (Efron & Ravid, 2013).

Sobel's (2004) place-based education pedagogy and Capra's (1997) notion of ecoliteracy helped validate the use of local problems and the local setting to engage students into action for sustainability while Ryan and Deci's self-determination theory (SDT) was utilized to study the relationships between engagement and motivation. Because engagement occurs when attitudes influence awareness, both cognitive and affective components must be studied (Yilmaz & Taş, 2018). Therefore, in order to study environmental awareness as a measurable construct, one must understand its multidimensional nature; if raising awareness is the goal, experiences presented must aim to increase the level of environmental knowledge (cognitive component), promote personal attitudes toward solving environmental problems (emotional component), and levels of participation in environmental activity (behavioral component) (Nazarenko & Kolesnik, 2018).

A lingering issue with studying engagement is the sometimes-contrasting viewpoints by researchers of the relationship between engagement and motivation (Reschly & Christenson, 2013). Some researchers use the two constructs interchangeably, while others view engagement as a result of student motivation. Because the more popular view seems to be that motivation is the pre-requisite to engagement, this action research will use the cause and effect relationship frame the methods (Saeed & Zyngier,

2012). If motivation is there, then engagement will be observed. Basic psychological needs, such as the level of autonomy, competence, and relatedness that individuals feel, affect the level of engagement and willingness to seek help from a teacher. SDT connects the constructs of engagement and motivation in relation to the three basic human desires for autonomy, competency, and relatedness (Ryan & Deci, 2000).

Brief Overview of Methodology

Action research differs from other methodologies in the sense that it does not look to gain knowledge for powerful generalizations across other settings and situations but seeks to enable change at the local level (Fraenkel, Wallen, & Hyun, 2012). Through a qualitative methodology framework, during a seven-lesson unit in the Spring of 2018, this study sought to test the impact that a place-based unit on composting in the STEM Lab had on 10 fourth grade students' environmental awareness levels. Though this impacts the validity of the study, convenience sampling was required during this study to keep students on their traditional six-day rotation Related Arts schedule.

Capra (2005) emphasized the need for curricula that teaches children the patterns which nature sustains life and allow members of a community to understand that sustainability is not an individual property, but one of an entire network. With the theoretical and conceptual frameworks of this study in mind, a seven-lesson place-based unit on waste reduction was created to strengthen students' ecoliteracy and stewardship at the local level. Prior to problem recognition, students were first presented with two environmental appreciation lessons through literature and outdoor exploration. After students were exposed to the ecological literacy concepts of nested systems and cycles of sustainability in nature, students were asked to evaluate their own actions at the local

level. This pedagogy, which is oriented toward connecting actions with full appreciation of nature's processes- the breath of life-, developed out of engagement theory (Capra, 2007). Engagement with projects that emphasis how their actions have consequences generate in students a strong sense of motivation and emotional connection (Capra, 2007). Whether intrinsically or extrinsically motivated, Deci and Ryan (1985) contend that an individual's motivation levels are highly affected by their perceived levels of competence and agency. Therefore, modeling and positive outdoor engagement in the classroom aimed to increase these psychological levels in the students. Pelletier et al. (1998) further emphasized the need for environmental knowledge and attitude for its effects on environmental behaviors. After motivation is activated through the consideration of cognitive and affective domains, student behavioral engagement toward developing solutions for human impacts at the local level will hopefully be observed.

Triangulation of data is required as data is collected and prepared for coding analysis. Quality criteria in qualitative research requires the researcher to understand the necessity of developing strong credibility during the methodologies portion of an action research. This is the level of trustworthiness and plausibility of the research findings. Triangulation of data and rich descriptions of events and researcher's positionality strengthen a qualitative study (Taylor, 2010). This study therefore utilized multiple instruments, such as surveys, open ended exit slips, Likert scales, semi-structured interviews, samples of student classwork, and field notes, to better understand the effects of ecoliteracy activities on student environmental awareness.

Significance of the Study

Meta-analysis of relevant literature indicates a need for such a study because a stronger orientation toward secondary-aged students is often found when evaluating EE and preferences are shown on fixed-response questionnaire surveys as opposed to open-ended interview studies (Rickinson, 2001). This signals a lack in quality research for elementary school teachers seeking a deeper understanding of what ecoliteracy might look like in pre-adolescent classrooms. Throughout this qualitative action research study, the two basic principles of education, a commitment to the student and to the profession, are reflective in the design process. Surveys, anecdotal field notes during interviews and classroom observations, exit slips, and product samples were collected to evaluate the effectiveness of the treatment. Therefore, studies like this one are essential to education as it looks to gain insight at the local level and find practical implications from knowledge constructed in the theoretical world.

Although the external validity of this study may be weak, it hopes to demonstrate the importance of careful reflection by all teacher professionals for social justice and student empowerment in their learning community. Furthermore, it looks for the effectiveness of student motivation and engagement during an ecoliteracy unit of study. While teachers ask for how to motivate their upper elementary students to learn, Deci (2015) explains that we are asking the wrong question. “It is not a matter of motivating (your students); it is a matter of creating the environment within which they would motivate themselves” (Tom Bilyeau Classics, 2015, 17:56). Although findings might be limited, the teacher-researcher hopes to encourage other educators to continue its quest

for innovative opportunities to enhance the learning experience by learning about motivational conditions that engage students.

Limitations of the Study

This study had limitations in place due to subject of study and college deadline requirements. Due to time restraints, only 4th grade students were studied during an 8-lesson length time. Also, this action research was conducted in a Related Arts classroom in which students only participated in the ecoliteracy unit every 6 days. Limitations, therefore, exist when generalizing to a larger population. In this participatory research study, the teacher-researcher must be cautiously aware of the threats to the internal validity. Because the goal of action research is to determine what might improve things in the local context and not generalizability of the findings (Mills, 2018), significance of the study still exists at the local level.

Possibilities of data collector bias, implementation, and attitudinal threats exist when conducting this type of research and therefore must be critically examined rather than ignored during the planning, implementation, and analyze of the results (Herr & Anderson, 2015; Fraenkel, Wallen, & Hyun, 2012). Another possible weakness within the data may be the Hawthorne Effect, in which participants improve their behaviors and attitudes due to the realization that they are being observed. During interviews and surveys, one must be aware of the possibility of someone responding how they think they should be instead of how they really feel, therefore skewing the results and creating a Halo Effect like the one found in Elton Mayo's study of work conditions at Hawthorne Work in Cicero, Illinois (Hindle, 2008). During Mayo's study, participants in the intervention group improved production, regardless of the different working conditions

being manipulated (Hindle, 2008). By triangulating the data, the researcher hopes to minimize weaknesses concerning this issue.

Findings in this study are not to be read as prescriptive, but descriptive within the context of the time and place for these selected number of students. Just as Howard (2002) explained after his qualitative study into the students' perceptions of their teachers' pedagogical choices, these limitations should not diminish the insight that was gained as perceptions and interpretations of data help with further discussions about the learning environments at Southeast Elementary.

Summary of the Findings

The finding of the study indicated that students increased their environmental awareness levels over the course of a 10-week place-based unit of food waste reduction. Specifically, the results across instruments specified that students' cognitive knowledge of composting increased; they also reported feeling more emotionally connected to nature and more empowered and motivated to continue participating in future ecoliterate actions to combat environmental issues of today's societies. The findings of this action research study thus support the inclusion of ecoliteracy units of study across subject areas at the elementary level. Student perceptions of the seven-lesson place-based unit were that they are essential for helping students understand how to help the planet. They also saw value in teachers utilizing the similar techniques in other subject areas to impact student engagement because they explained that the outdoor setting makes learning "more fun" and "more relaxing." Field notes from the teacher-researcher also concluded that there may be value in also utilizing the ecoliteracy's principles of sustainability and cultivation of emotional, social, and ecological intelligences in student as a framework for promoting

classroom and school citizenship. The action plan developed from the findings of this study detail how findings are shared with peer teachers and makes suggestions for future research.

Positionality

Because of the nature of the qualitative research model, the researcher organically materializes into an essential data collection instrument (Bourke, 2014). They decide the topics to research, the ways to measure the impact, and decides on the implications of the findings. That is why "who" the researcher is becomes a vital part of the action research design. As a middle class, non-disabled, white female, my values, cultural experiences, and family upbringings shaped my current study. For instance, growing up in a rural midwestern town, our summers where spent exploring the cornfields and creek beds for natural treasures. We participated in 4-H where we would win ribbons at the county fair for our wildflower arrangements or small livestock. Each meeting would start with the club pledge: *I pledge my **Head** to clearer thinking, my **Heart** to greater loyalty, my **Hands** to larger service, my **Health** to better living for my club, my community, my country and my world.* As I reflect on my life choices, much of them appear to have followed this mission statement: becoming a teacher, making sure I am active and eating healthy, working on my doctorate, recycling and composting, and cleaning up trash. I always opted for an outing of hiking over sitting on beach. I became a certified *Master Naturalist* through the Clemson University Extension Office and am continuously found seeking new creatures during forest explorations.

My love for the outdoors has clearly influenced my decisions to study ecoliteracy at the local level. Dejectedly, I watched as students appear to have a growing disconnect

with nature and appear to have lacked the experiences of my outdoorsy upbringing. State-mandated curriculum and popularity of online video gaming have continued to isolate our children into a metaphoric box, resulting in what some researchers and environmental psychologists are labeling "biophobia," a "prejudice against nature" (Campbell, 2017, para. 3). Instead of blaming society, the parents, or the schools, I sought change within my locus of control: my classroom setting. Throughout the years I built my curriculum and instruction decisions around the idea that an effective learning environment was often a noisy one and always sought out innovative new ways to teach the students the standards. I felt my decisions were always communitarian in nature as I looked to create a holistic learning environment for the benefit of each of my diverse populations of students. This study appears to do the same.

The level of quality in an action research can be referred to as its rigor (Mertler, 2017). Because qualitative methodologies are always consisting of descriptive, narrative accounts, it is vital that certain criteria are adhered to in order to strengthen the claims of the study. Through the diversity of approaches, there is no one single method that guarantees trustworthiness in a study, but literature suggests that "good" studies possess certain characteristics (Campbell & Machado, 2013). First, richness in a qualitative study requires a seamless flow between the theoretical constructs, data sources, context descriptions, and samples and is shown to have transferability across a variety of settings (Taylor, 2010). "Good" studies triangulate data and provide rich descriptions of events and researcher's positionality to help strengthen the credibility of the research (Taylor, 2010). Finally, they are described as communitarian in nature because of the "desire of those who discuss such research to have it serve the purposes of the community in which

it was carried out, rather than simply serving the community of knowledge producers and policymakers" (Lincoln, 1995, p. 275).

Reflexivity, or the careful evaluation of the positionality of the research, involves a "self-scrutiny on the part of the researcher; a self-conscious awareness of the relationship between the researcher and an 'other'" (Bourke, 2014, p. 2). My insider positionality requires me to carefully watch for biases that develop during the data collection and analysis portions of this action research study. My position as a related arts teacher further complicates the relationship that exists between myself and the students.

This positionality and the setting of the study are very important in qualitative research. These standpoint epistemologies are "always partial and incomplete; socially, culturally, historically, racially, and sexually located; and can therefore never represent any truth except those truths that exhibit the same characteristics" (Lincoln, 1995). Taylor (2010) explained, due to this fact, statistical generalizations are inapplicable to a larger audience. Aside from this, knowledge generated through worthy qualitative methods can still be transferable in other settings, populations, and circumstances (Taylor, 2010).

Dissertation Overview

Chapter One of this dissertation included the theoretic background for constructs of study, specifically ecoliteracy, environmental awareness, and motivation. Chapter Two offers a review of relevant literature as a resource for deeper conceptual understanding of the evolution of EE and the theories that support the development of this study. Chapter Three outlines the methodologies in use during the seven-lesson unit administered in the STEM Lab. It also includes detailed descriptions of socio-economic and cultural demographics of student population who participated in the study as it looks to strengthen

the trustworthiness of this study. Qualitative data, including excerpts of interviews with participants, exit slips, and student samples, can be found in Chapter Four and Five, along with implications of the study with recommendations for further research.

Definitions of Terms

Action research – Action research differs from traditional dissertation formats because of its distinct local perspective. It seeks acknowledge that can be used in the local setting but also is transferable to other settings for public knowledge (Herr & Anderson, 2015).

Awareness – Knowledge and understanding that something is happening or exists (Merriam-Webster, n.d.).

Ecoliteracy – Also referred to as ecological literacy, addresses the interconnectedness of your world. It provides a model of education which experiences are provided to the children with the goal in mind of cultivation of their emotional, social and ecological intelligences (Bennett, 2012).

Ecoliterate – The result, or end goal, of someone who engages in socially and emotionally engaged ecoliteracy (Goleman, Bennett, & Barlow, 2012).

Ecological Intelligence – The capacity "to understand the ecological context in which humans live, to recognize limits, and to get the scale of things right" (Orr, 2004, p. 2).

Engagement – Students "being attracted to their work, persisting despite challenges and obstacles, and taking visible delight in accomplishing that work" (Downes & Bishop, 2012, p. 7).

Environmental Awareness – Broadly defined as the individual's attitude regarding environmental consequences of human behaviors (Ham, Horvat, & Mrćela, 2016).

Environmental Education (EE) – Educational approach that allows individuals to discover environmental issues, engage in problem solving, and help empower to improve the environment for future (epa, n.d.).

Inquiry Based Learning – Students are provided a challenge (such as a question to be answered, an observation or data set to be interpreted, or a hypothesis to be tested) and accomplish the desired learning in the process of responding to that challenge (Prince & Felder, 2007, par. 5).

Interdisciplinary – Interdisciplinary teaching includes "the use and integration of methods and analytical frameworks from more than one academic discipline to examine a theme, issue, question or topic" (Carleton College, 2010).

Place Based Learning – A pedagogy "of community, the reintegration of the individual into her homeground and the restoration of the essential links between a person and her place" (Sobel, 2004, p. ii).

PLC – "A professional learning community, or PLC, is a group of educators that meets regularly, shares expertise, and works collaboratively to improve teaching skills and the academic performance of students" (Hidden Curriculum, 2016, par. 1).

Sustainability – Includes individuals' awareness of meeting material needs by avoiding ecological degradation with a consciousness toward all the natural and social dimensions of the web of life (Capra & Stone, 2010).

STEM – This is the acronym for interdisciplinary units, including Science, Technology, Engineering, and Mathematics.

CHAPTER TWO

LITERATURE REVIEW

This chapter provides a review of literature associated with constructivism and its influences on EE, along with the historical evolution of its focus to eventually include more of a solution-based approach to the environmental issues of today. Capra and Stone (2010) operationally define the inclusion of EE as one that fosters the sustainability of practices to include individuals' awareness of meeting material needs by avoiding ecological degradation with a consciousness toward all the natural and social dimensions of the web of life. In other words, instead of teaching to despair, an alternative approach to EE is one that fosters shared experiences in which students work to "discover value in the natural world," experiential activities that "encourage the exploration of what we believe and who we are" and provide reflection on how we intend to live in the world (Burgess, 2010, p. 2).

Because Klien and Merritt (1994) found correlations between the goals and principles presented in constructivist learning theories and EE, constructivism and its influence on student-center models in science classroom were first examined. The evolution of EE into then ecoliteracy was then explored. This was followed by literature regarding place-based learning in order to contextualize the necessity of learning at the local setting. Finally, a summary of relevant research was utilized to display the contrasting, and often politicized, information that existing about EE's effects on student

populations. The literature review concludes with Ryan and Deci's SDT of motivation to help operationally define environmental awareness in the school setting.

Constructivism

Giron, Vasquez-Martinez, Claudio-Rafael, and Banuelos (2012) demonstrated the synthesis of ideologies within constructivism and EE frameworks by explaining that "the constructivist approach of showing students how to construct knowledge, promotes collaboration with companions in the process of reviewing multiple perspectives that can be brought to bear on the solution of a problem" (p. 142). Constructivist teachers ensure that learning experiences include problems that are important to the students and not just related to the needs and interests of the teachers and the educational system (Amineh & Asl, 2015). Social Constructivism highly emphasizes the collaborative nature of learning. When Vygotsky (1978) branched away from the traditional constructivism idea that learners are outside of their environment, he placed a heightened role of the student's place and their interrelationship with it. Piaget (1939) and other constructivists believed that learning was an active, highly individualized process in which students built on pre-existing knowledge and personal experiences which led teachers to question their roles in this type of learning theory (Beerenwinkel & Arx, 2017). Vygotsky instead thought that the learner and their environment co-create knowledge. He argued that all cognitive functions are born in social interactions and stressed the important role that language and culture have on cognitive processing. In this theory, teachers were described as facilitators of learning as they guide students to actively discover their new knowledge in an engaging classroom environment (Amineh & Asl, 2015). Because social constructivism concluded that cognitive growth happens first at the social level and later

develops into the individual level, it concluded that collaboration and interactions opportunities must therefore be carefully planned out during curriculum development in order to increase cognitive processing (Churcher, Downs, & Tewksbury, 2014).

Learning, according to Vygotsky (1978), "awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers (p. 90). Vygotsky's (1978) social constructivism theory guides the development by emphasizing the need to view knowledge growth through the influential intrinsic and extrinsic factors. Karimi-Aghdam (2017) argued that Vygotsky's Zone of Proximal Development, or ZPD, is a "temporal and transitional interface of inter-psychological and intra-psychological planes of human development" (p. 82), and that the speaking activities give rise to novel collective experiences and higher-level functions.

Von Merriënboer and Sluijsmans (2009) expressed how the approach to learning tasks in today's modern classroom can "stimulate learners to integrate the knowledge, skills, and attitudes that underlie the performance of realistic tasks, and so help them construct a knowledge base that allows for transfer of what is learned to solving new problems in unfamiliar situations." (p. 55). Yet, they went on to explain how this approach is often "excessive for novice learners and may seriously hamper learning," thus proving the importance of professional development for novice teachers in this area before implementation. Robottom (2004) argued for approaches to EE that adopt more of a socially constructivist perspective so that cognitive needs are met while also focusing on learners' apprehension of such content. There is a necessity for an EE which encourages constructivist learning and supports in the rebuilding of the ways that society

conceptualizes sustainability (Giron, Vasquez-Martinez, Claudio-Rafael, & Banuelos, 2012). Although constructivism has long been an important discourse in educational research, it has been far more visible in science education than EE research (Robottom, 2004).

Historical Overview of Environmental Education

To effectively discuss the evolution of the definition and characteristics of ecoliteracy and to defend the necessity of its development through school curricula, it is first necessary to summarize the history of EE itself. EE is an interdisciplinary field of study that looks to strengthen the cognitive and affective areas of an individual (Ayaydin, Un, Acar Sesen, Usta Gezer, & Camici Erdogan, 2018; Yilmaz & Taş, 2018). The goal of EE is to "produce citizens who are knowledgeable about the biophysical environment and its problems, aware of strategies that can be used to deal with those problems, and actively engaged in working toward their solution" (Stapp et al., 1969, as cited in Fisman, 2005, para. 1). It is seen by many as one of the keys to overcoming the current environmental crisis (Boeve-de Pauw & Van Petegem, 2018; Simsekli, 2015). Learning experiences, as explained through a constructivist lens, are then shaped to include problems that are important to the students and not just related to the needs and interests of the teachers and the educational system (Amineh & Asl, 2015). Developed with one's own community in mind, it looks to strengthen knowledge, problem solving skills, and environmental sensitivity by focusing on environmental issues from both a regional and global perspective (Locke, Russo, & Montoya, 2013; Tilbury,1995).

While the words "environment" and "education" were not used in conjunction with each other until the mid-1960s, the evolution of EE has integrated the significant

influences of such great thinkers of the 18th and 19th centuries as Rousseau, Froebel, Dewey, and Montessori (Palmer, 2003). For instance, Dewey longed for educational environments that enabled a deeper level of inquiry to support connections between experiences and self-reflection pioneered the way for holistic and interdisciplinary approaches to learning that incorporated method and subject matter (Thorburn & Allison, 2017).

While many influential pioneers contributed to the EE, many have attributed its development in western society to a town planner, Sir Patrick Geddes (1854-1933), who made the important link between the quality of the environment and the quality of education (Palmer, 2003). Others have attributed the origins of EE in America to Wilbur Jackman's *Nature Study for the Common Schools* (1891) and the resulting promotion of nature and outdoor studies (Rieckenberg, 2014; Stevenson, 2007). Eventually, urban migration in the early 20th century caused increasing concerns of American youth losing opportunities to learn from direct contact with nature which anchored the EE in public education (Fraser, Gupta, & Krasny, 2015). The primary purpose of nature study was—and still is—to foster an understanding and appreciation of the natural environment through first-hand observations (Stevenson, 2007).

With the "environmental era" beginning in 1970 with Earth Day, the coalescence of a broad "environmental movement," the signing of the National Environmental Policy Act, the creation of the Environmental Protection Agency, and the enactment of over a dozen sweeping new federal laws for environmental protection and ecological preservation (Andrew, 2006; Tilbury, 1995). This movement resulted in EE focusing on learning about the natural sciences, such as field ecology, nutrient cycles, and plant and

animal taxonomy, and later evolved into the issue and catastrophe education that fixated on learning about rainforest destruction, ozone depletion, and endangered species (Sobel, 2004). In the late 1990s, EE evolved from the apolitical and scientific work carried out in the 70s and early 80s to one which not only considers immediate environmental improvement as the overarching goal, but also emphasizes greater support for an educational approach that addresses our world's interconnectivity (Kates, 2001; Tilbury, 1995).

Although the concept of 'sustainability' arose in the early 1980s, it was not until the 1990s that this shift in focus began to emerge in EE (Caradonna, 2014). This systemic thinking allowed for new focuses and programs to materialize under the EE umbrella. After ecology, eco-pedagogical approaches such as ecological literacy, education for sustainability (EfS), environmental sustainability education (ESE), ecoliteracy, and place-based education were created to emphasized the necessity for educators to use the role of home when strengthening students understanding of the world's interconnections and interdependencies amongst all life (Cirillo, 2016). Though often used interchangeably, differences exist in their focus. Even amongst the pedagogical variations, the goal of these frameworks is the same: to create a sustainable society. To sustainists, sustainability means "planning for the future and rejecting that which threatens the lives and well-being of future generations" (Caradonna, 2014, p. 6). While often associated with environmental issues such as pollution or green energy, sustainability is equally interested in social sustainability and sensible economics and the interconnectedness of these three domains (Capra 2007; Caradonna, 2014). Therefore, a society must address not only environmental but also social and economic issues in order to be considered

sustainable. Capra's ecoliteracy pedagogy best fits into this multidimensional view of a sustainable society. It cultivates "the knowledge, empathy, and action for practicing sustainable living" (Goleman, Bennett, & Barlow, 2012, p. 2).

Therefore, the evolution of the ecoliteracy framework was clarified below. First, ecology's role in the development of deeper understandings of interdependency and nested systems amongst organisms was described. Then, Orr's (1992) ecological literacy was detailed to highlight the shift in focus to one where humans' role within these ecological networks received increased attention. Finally, the idea of utilizing nature as society's model for sustainability was explained in Capa's (2007) ecological literacy framework and helped provide the catalyst for increased opportunities for outdoor learning opportunities in ecoliteracy units of study.

Ecology

The term "ecology" derives the Greek prefix ("eco" for oikos-meaning 'house') and the root word ("logo" for ʎoyia- meaning a "body of knowledge"). When put together, they mean "science of habitat" (Boehnert, 2012; Capra & Luigi Luisi, 2014). Ernest Haeckel (1866) coined the word when he used it to describe the process of studying the relations between an organism and its surrounding outer world. Because living systems are rooted in patterns of relationships, understanding the principles of ecology require individual to go against the traditional Western science and education linear model to one in terms of relationships, connectedness, and context (Capra, 2007).

Creative ecology is built on the foundation of deep sensitivity to natural patterns and processes (Dalton & Sala, 2001). This systematic thinking emphasizes "the awareness of unintended consequences, counterintuitive effects, cycles, dynamics and

patterns in an attempt to put knowledge in context" (Boehnert, 2012, p. 50). This systematic thinking became central to both the development of Orr's (1992) idea of ecological literacy and the design for sustainability which developed in the 70s. Sonnleitner, Konig, and Sikharulidze (2018) warn that our whole civilization will only succeed if it obtains a much greater knowledge of systemic connections in complex systems and that, thus, "deep changes in the educational system [are] a requisite for sustainable societies" to underpin a "personal mission in research and teaching to develop valid, high-quality assessment methods" (p. 1341).

Ecology emerged from the society's increased awareness of systemic relationships within nature but often fixated on the element of despair. Deforestation of rainforests, endangered species, often were utilized to call students to action. Leopold (1987) warned of these types of approaches by explain that the penalty of an ecological education is the feeling of living alone in a world of wounds. Shortly after, a new field of sustainability science emerged as a growing population of individuals sought a better understanding of preponderantly societal and political processes affecting nature (Kates et al., 2001). Ecological Literacy, Ecoliteracy, Education for Sustainability (EfS), Environmental Sustainability Education (ESE) and Place Based Education were all frameworks that resulted from this evolution over the years. They aim to heal the wounds that Leopold (1987) eluded to by providing classroom frameworks to help educators live and act decisively in "favor of ecological, economic, and cultural integrity" (Burgess, 2010, p.2).

Ecological Literacy

Roth (1968) coined the term environmental literacy and Orr (1992) refined it as "ecological literacy." Although at times Orr's (1992) work ambiguously used both phrases, he is best known for using ecological literacy to emphasis systemic relationships that humans have with nature (Cutter-Mackenzie & Smith, 2003). Earlier frameworks originally emphasized essential knowledge components only, but more recent frameworks focus on cognitive skills, particularly scientific inquiry and ecological thinking (McBride et al., 2013). In the broadest sense, EE strives to develop and strengthen the ecological literacy of individuals and society.

While focused on the understanding of the interconnections amongst the natural and human systems, its biocentirc and ecocentric views support the paradigm that humans have the moral responsibility to embrace sustainability because of the way that human systems are nestled within natural systems (Barnes, 2013; Stone, 2007). Just as the North American Association for Environmental Education, or NAAEE (n.d.), included the themes of systems, interdependency, the role of where one lives, and roots in the real world, ecological literacy aims to immerse students to the notion of interconnectivity instead of the dated idea that we exist outside of our environment and its problems.

By applying systems thinking to the multiple relationships located on Earth, Capra (2007) concluded that we could identify core concepts that describe the patterns and processes by which nature sustains life. He postulates that it is imperative for curricula to be developed with nature as the exemplar model to teach children about the fundamental facts of life, sustainability, and community dependability (Capra, 2007).

Examining nature and identifying the difference between a living and dead organism, what scientists call "metabolism", thus becomes the guiding principle of ecological literacy. This natural phenomenon, what was later poetically labeled "breath of life", guided in the development of this pedagogy.

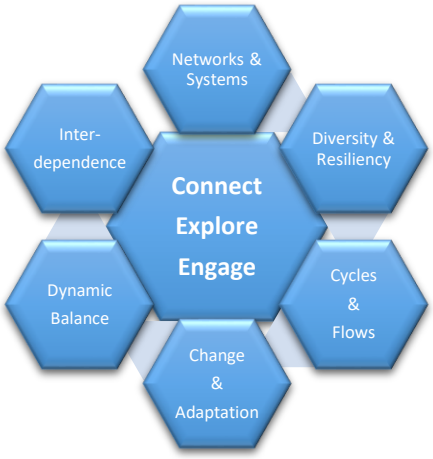

Figure 2.1. The six patterns and processes by which nature sustains life. Adapted from Capra, F. (2005). Speaking Nature's Language. In M. Stone & Z. Barlow (Eds.), Ecological literacy: Educating our children for a sustainable world, (pp. 18-29). San Francisco, CA: Sierra Club Books.

To understand the "breath of life," two aspects must be studied; one is the "continual flow of energy and the cycling of matter" and the other is the "network of chemical reactions that process food and forms the biochemical basis of all biological structures, functions, and behaviors" (Capra, 2007, p. 13). By studying thousands of different ecosystems and their naturally occurring interdependencies, sustainable communities can be operationally defined, and the principles of sustainability can be established. Capra's (2007) present formulation includes the following: (1) networks, (2) nested systems, (3) interdependence, (4) diversity, (5) cycles, (6) flows, (7) development, and (8) dynamic balance (Stone, 2012).

1. Networks – All living things are interconnected through networks of relationships. This web of life makes survival possible. For example: pollinators and plants in the garden.
2. Nested Systems – Nature is made up of systems that are nested within other systems. Each individual system is an integrated whole and part of larger systems at the same time. Therefore, changes within a system can affect the sustainability of the systems nested within it as well as larger systems of which it is a member.
3. Interdependency – No creatures can live in isolation. Organisms coexist because of the careful balance of dependency that exists amongst them. Animals depend on the photosynthesis of plants for their energy; plants depend on carbon dioxide produced by animals and on the nitrogen fixed by bacteria at their roots. Only through the collaborative work can all organisms work together to regulate the entire biosphere and maintain the conditions conducive to life.
4. Diversity – In nature, a diverse ecosystem will be resilient because it requires species to overlap ecological functions that partially replace one another. Even with severe disturbance in the network, a diverse community will be able to survive and reorganize itself because of the overlapping links. Therefore, the more complex, the more resilient the community will be. In the human community, ethnic and cultural diversity play a similar role. Diversity means many different relationships, many different approaches to the same problem.
5. Cycles – Members of the nested systems rely on the exchange of resources in continual cycles. For instance, the water cycles in a garden are also part of the global water cycle.

6. Flows – Each organism is depended on the continual flow of energy for survival. The constant flow of energy from the sun sustains life and drives most ecological cycles.
7. Development – All life changes over time. Organisms develop and learn, adapt and coevolve with their ecosystems. For instance, hummingbirds and honeysuckle have both adapted in ways to benefit each other; their color vision and slender bills coincide with the appearance of the flowers.
8. Dynamic Balance – Ecological communities act as "feedback loops, so that the community maintains a relatively steady state that also has continual fluctuations" (Stone, 2012, para. 10). This careful balance creates and maintains a resiliency in the face of ecosystem change. For example, ladybugs eat aphids in the garden. When the aphid population goes down, so does the ladybugs' numbers. This eventually increases the aphid numbers because of a lack of predator but their surge in numbers will then support more ladybugs. Individual species rise and fall, but natural balance within the system allows them to thrive together.

At the core of this systemic thinking, one can identify a "fundamental change of metaphors: from seeing the world as a machine to understanding it as a network" (Capra, 2015, p. 242). For long-term survival, society must commit to shifting its understanding of sustainability from economic growth or competitive advantage to the very principles of "breath of life" found within nature's own systems. Capra (2015) concluded, "The systemic understanding of life has given us the knowledge and the technologies to build a sustainable future. What we need is political will and leadership" (p. 249). Ecoliteracy

becomes the pedagogical framework which helps guide educators in developing a learning environment that fosters this leadership.

Ecoliteracy

According to Dewey (1910/1997), intellectual intelligence does not exist separate from the attitudes, feelings, and emotions. In 1995, Daniel Goleman furthered this idea in his book *Emotional Intelligence: Why It Can Matter More than IQ*. Drawing on brain and behavioral research, he widened the definition of intelligence for educators today (Goleman, Bennett, & Barlow, 2012). As a result, three separate types of intelligences emerged: emotional, social, and ecological. Ecoliteracy recognizes these three essential dimensions of universal human intelligence as networked within each other. In other words, to cultivate one, you help cultivate the others (Bennett, 2012). Although the Center for Ecoliteracy acknowledges that this cultivation can take many forms, they identify two core dimensions as guidelines to help educators in this process (Bennett, 2012). The first one is effective by looking to foster an empathy for all forms of life (Bennett, 2012). Thus, the intent is to encourage a sense of caring that is not just reserved for human being but extended to all forms of life (Bennett, 2012). The other guideline is cognitive or related to how we think. By using Capra's (2007) ecological literacy principles of systems thinking, students must understand how nature sustains life through the interdependency of certain nature patterns and processes such as cycles, networks, and nested systems (Bennett, 2012).

Socially and emotionally engaged ecoliteracy, therefore, inspires us to collect and share information and to collaboratively act to foster sustainable living. Bennett (2012) suggests that "school communities — which, like ecosystems, come to life through

networks of relationships — are ideal places to nurture this new and essential ecological sensibility" (para. 9). Roy, Kihoza, Suhonen, Vesisenaho, and Tukiaianen (2014) argued, however, that education fails to provide opportunities to connect learners' abstract knowledge with their active world; it only promotes inert learning. Without enabling personal transformation and fixating on measuring students only by academic success on a standardized test score, the learning in most classrooms only promote narrow and individualistic views among the students (Roy et al., 2014). By embedding sustainability principles into the classroom, educators are instead empowered to renovate old systems based on "competitive principles and values and to introduce a culture of sustainability and peace in the school communities" in order to begin reimaging the culture of American educational systems as being more cooperative and less competitive (Gadotti, 2010).

With the goal of nurturing students to become ecoliterate, Goleman, Bennett, and Barlow (2012) proposed five vital practices for educators that integrate emotional, social, and ecological intelligence into the classroom to strengthen and extend a student's capacity to live sustainably:

1. Develop empathy for all forms of life: Ecoliterate citizens cultivate compassion toward all forms of life because of their understanding that humans are members of a broader community that includes all living things (p. 12). Learning opportunities should thus help students recognize humans as begin members of the larger web of life (p. 10).
2. Embracing sustainability as a community practice: Ecoliterate citizens understand that the quality of the web of relationships within any living community is

determined by its collective ability to survive and thrive together (p. 10). Educators provide opportunities for students to learn about the various ways that plants, animals, and other living things are interdependent and, in turn, inspire students to see the interconnectedness within their communities and see the value in strengthening those relationships by thinking and acting cooperatively (p. 11).

3. Making the invisible visible: Ecoliterate citizens possess an awareness that impacts of human behaviors are expanded exponentially in time space, and magnitude, making measuring the results impossible to fully understand (p.11). Therefore, educators should use a variety of strategies, such as web-based tools for visualization and social networking, to help make the invisible visible and enable action in more life-affirming ways (p. 14).
4. Anticipating unintended consequences: Ecoliterate citizens adopt systems thinking and the "precautionary principle" as guidelines for cultivating a way of life that defends rather than destroys the web of life (p.10). Educators should help students develop the skills to think about unanticipated consequences of everyday human behaviors. Because students who can apply systematic thinking are usually better at predicting possible consequences, opportunities to map interconnections can help students grasp the complexity of our decisions and their implications (p. 16).
5. Understanding how nature sustains life: Ecoliterate people recognize that they are members of a "web of diverse relationships within their communities and beyond"; they tend to be more that systems are nested within other systems and collectively practice a way of life that "supports nature's inherent ability to

sustain life into the future (pp. 16-17). Educators must help students turn to nature as their teacher to learn these critical tenets (p. 16).

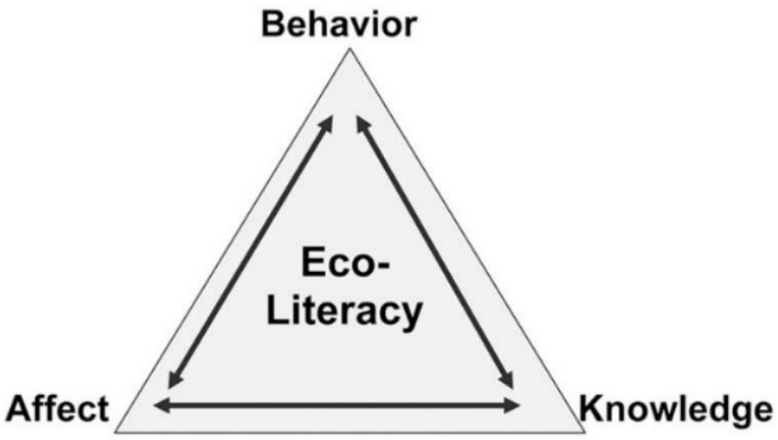

Figure 2.2. *The interconnectivity between behavior, affective, and cognitive domains in development of an individual's levels of ecoliteracy. As cited in Bruyere, B. (2005). The effect of environmental education on the ecological literacy of first year college students. Natural Sciences Education, 37(1), 20-26.*

Like Capra (2007) explained, a multifaceted pedagogy "must foster in learners an understanding of nature's principles, a deep respect for living nature, and long-lasting relationships with the nature world" (p. 18). In David Sobel's (1999) book *Beyond Ecophobia: Reclaiming the Heart in Nature Education*, it is argued that too often EE focuses on the problems and crisis which, especially in younger children, can leave them feeling disempowered and hopeless. With the increasing sentiment within and outside the EE community that these types of "doom and gloom" approaches often turn people off to the message that actions can positively impact the world, new frameworks began to evolve (Saylan & Blumstein, 2011). Alternative approaches with ecological literacy as the framework instead emphasis the joy and wonder of the natural world by asking children to immerse themselves in nature and observe carefully the network systems. By

encouraging active learning and shared decision making, curriculum decisions made with ecoliteracy in mind attempt to move beyond despair and provide constructive, optimistic action in the face of today's significant environmental challenges (Burgess, 2010; Goleman, Bennett, & Barlow, 2012). Where students are challenged to inquire into local concerns and engage to solve real community problems is specifically called place-based learning. Instead of focusing only about familiar aspects of their place, place-based education forces students to contemplate critically about their places and consider the diversity of their place and the people within it (Deringer, 2017).

Place-Based Education

In an interview, Nijhuis (2011) asked Saylan (2011) why EE has failed to move our society into action. He replied that the biggest thing that's lacking is relevance. Therefore, teaching toward sustainability best fits within the frameworks of place-based and project-based pedagogy (Vanderbilt University, 2018). Sustainability practices thrive in place-based learning (Gritter et al., 2016). It is better theoretically supported framework than Forest School (see p. 58 for more details) (Loyd, Truong, & Gray, 2018; Sharma-Brymer, Brymer, Gray, & Davids, 2018; Knight, 2011) and is less polarizing than "environmental education" or "education for sustainability" (Sobel, 2004).

Called place-based education, or PBE, its supporters have been "striving to make the boundaries between schools and their environs more permeable by directing at least part of students' school experiences to local phenomena ranging from culture and politics to environmental concerns and the economy" (Smith, 2007, p. 190). It is the process of using the local community and environment as a starting point for teaching all subjects across the curriculum with hands-on, real-world learning experiences (Sobel, 2004).

Place-based education is "about connecting people to people, as well as connecting people to nature" (Sobel, 2004, p. 62). One of its core objectives is to analyze how landscape, community infrastructures, watersheds, and cultural traditions all interact and shape each other (Sobel, 2004, p. 9). Because of its emphasis on incorporation of community, PBE can often be difficult to define because of is adaptability into a wide range of locales (Smith, 2002). Smith (2002) therefore identified five thematic patterns of PBE that can be adapted to different settings: (a) cultural studies, (b) nature studies, (c) real-world problem solving, (d) internships and entrepreneurial opportunities, and (e) induction into community processes (pp. 587-590). These patterns were offered as a guide for teachers and community members who seek to move their classroom and schools in this direction.

In classrooms where place-based education is embraced, inquiry into local concerns and critically thinking to solve problems helps shape the learning environment and activities more than a standardized curriculum and allows for teachers and students to function more as "collaborative team members than as bosses and employees" (Smith, 2007, p. 192). Lowenstein and Smith (2017) emphasized that the "most powerful lever for youth and teachers to become their best selves is public affirmation and a powerful sense of belonging to a community" (p. 56).

Experiences with place-based education "increases community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens" (Sobel, 2004, para. 18). Just as other educational initiative and program adoptions, teacher training is vital for effective place-based integration (Goodlad & Leonard, 2018). In Power and Green's (2014) study, many

preservice teachers self-reported the notion of integrating place-based pedagogy in an already "crowded curriculum" as highly daunting but were able to realize how easy it is to combine these activities with curriculum requirements through training. Specifically, it was reported that many participants in this study came to understand how a place pedagogy framework was not about increasing curriculum content but more focused on enhancing curriculum possibilities through new ways of thinking about teaching and learning (Power & Green, 2014). Ray, Wei, and Barrett (2013) also reported positive impacts of training on educators when they found that intensive place-based interdisciplinary professional development on garden learning led practicing teachers to report increased attitudes and comfort with embedding ecological literacy into their future instructional and curriculum decisions.

Effects of Environmental Education

Some have suggested that students' awareness, attitudes, and achievement levels toward the environment increase when exposed to learning outside of a traditional classroom setting (Fisman, 2010; White, Eberstein, & Scott, 2018). Although most impact studies have focused on high school and college demographics, school interventions have been shown to be effective in impacting students' as young as four to five years old in developing perceptions of belonging to a complex system and raising awareness of the importance of preservation of life on Earth (Miranda, Jófili, & Carneiro-Leão, 2017).

While positive results have been reported, participation in EE have shown mixed results on the effectiveness of manipulating student cognitive, affective, and behavior. Like other content domains, this may be attributed to the plethora of instructional and

curriculum decisions represented in the EE units studied, thus supporting the need for careful planning during unit development. Cincera and Krajhanzl (2013) found that the single most important factor in contributing to students' action competence in sustainably behaviors was their participation in the decision-making processes at the school. This indicates that lack of positive effects on student behaviors are connected to problems with its implementation within the school systems. Boeve-de Pauw, Gericke, Olsson, and Berglund (2015) also added to the argument that pedagogical approaches are highly influential in EE's effectiveness on students' cognitive, affective, and behavior levels in sustainability practices when they indicated that schools where higher levels of holistic approaches to content resulted in more knowledgeable students about sustainability and those where more pluralistic pedagogical approach reported more frequent sustainable behaviors.

Table 2.1

Conflicting Research Findings of Impact of EE

Research findings of impact of EE	***Support claim***	***Reject claim***
• *Increase in cognitive development*	• Upadhyay & DeFranco, 2008 • White, Eberstein, & Scott, 2018; Fisman, 2010 • DiEnno & Hilton, 2005 • Al-Blushi & Al-Aamri, 2014	• Williams et al., 2018
• *Student motivation increases*	• Boeve-de Pauw & Van Petegem, 2018	• Sass, Boeve-de Pauw, Donche, & Petegem, 2018

• *Raise in environmental awareness and attitudes*	• Simsekli, 2015 • DiEnno & Hilton, 2005 • Nadelson & Jordan, 2012 • Al-Blushi & Al-Aamri, 2014	• Dimopoulos, Paraskevopoulos, & Pantis, 2008) • Bergman, 2016
• *Increase in engagement/motivation levels for environmental change*	• Lord, 1999 • Skinner & Chi, 2012	• DiEnno & Hilton, 2005
• *Gender differences exist in environmental awareness*	• Alp, Ertepinar, Tekkaya, & Yilmaz, 2008 • Coertjens, Boeve-De Pauw, Maeyer, & Petegem, 2010	• Genc 2015

Effects of Exposure to Outdoor Learning

Growing attention to PBE has prompted the consideration of evaluative and assessment practices and is evident through the growing body of literature now attempting to measure the impacts of place-based programs (Zandvliet, 2012). Since the mid-1970s, outdoor education has emerged as a recognized form of educational practice with the aim of heightening awareness of and fostering respect for self, others and nature (Wattchow & Brown, 2011). This was further supported by Vygotsky's (1978) theory of cognitive development when he concluded that knowledge is co-constructed in the environment (inter-psychologically) with others (as cited in Churcher, Downs, & Tewksbury, 2014). Therefore, it can be concluded that where the learning takes place may have a lasting impact on knowledge growth.

Besides increasing motivation levels in individuals (James & Williams, 2017; Bolling, Otte, Elsborg, Nielsen, & Bentsen, 2018), outdoor classrooms can increase

environmental awareness as well. For example, Nazir and Pedretti's (2016) case study of nine outdoor educators found that environmental awareness raises when people are exposed to deeply engaging experiences which help connect them to their environment, foster care for the environment, and build agency for the environment. The findings of Farmer, Knapp, and Benton (2007) study suggested that students retain the long-term environmental and ecological content and pro-environmental attitude better through outdoor experiences. After studying 8th grade students during a 12-day science unit of study, Lodhi, Shakir, Hussain, and Abid (2017) also found significant positive effect of outdoor education on the student learning. It appears that outdoor education enriches the academic achievements and social developments of the students when they are exposed to field work.

One outdoor educational program receiving increasing attention globally is the Scandinavian idea of Forest Schools. When tasked with defining what this framework looks like in the United Kingdom, Knight (2011) proclaimed that the philosophy of Forest School is to "encourage and inspire individuals through positive participation during engaging, motivating and achievable activities in supportive natural environments" (p. 590). This is supported by the main tenet of Ryan and Deci's SDT, in which individuals should be supported in ways that aid the development of their intrinsic tendencies rather than be controlled externally through strict rules, rewards or punishments (Barrable & Arvanitis, 2019). While most educational institutions rely on positive reinforcements, such as grades and awards, the Forest School's (FS) learner-centered approach nurtures children's curiosity and inherent tendencies to learn and

explore the world around them, in a natural setting as a way to attempt to capitalize on children's inherent motivational tendencies to learn (Barrable & Arvanitis, 2019).

Many have cautioned that The Forest School movement pedagogically has been under-theorized and under-researched in diverse contexts (Knight, 2011; Loyd, Truong, & Gray, 2018; Sharma-Brymer, Brymer, Gray, & Davids, 2018). Alternatively, place-based outdoor learning as a place-responsive approach allows for educators to broadly integrate learning by providing experiences to interconnect the learners with their curriculum and place (Loyd, Truong, & Gray, 2018). Place-responsive pedagogy integrates being present in, and with, a place, and recognizes the power of place-based stories and narratives on individuals (Mannion, Fenwick, & Lynch, 2013; Wattchow & Brown, 2011). Within this framework, "learners' cognitive structures can be altered, attitudes can be modified and the general learning environment that develops around these programs can enrich and stimulate further learning" (Zandvliet, 2012, p. 128).

As this responsive way of thinking is a pedagogy, rather than a program, there is no danger of a "one size fits all" approach to the learning taking place. Yet Mannion, Fenwick, and Lynch (2013) suggested that educators willing to embrace a place-responsive pedagogy require a degree of "flexibility, creativity, a recognition of differences found in the ecological and social domains, and the ability to respond to places and the entities found there via the contingent facilitation of pupils' first-hand experiences" (p. 803).

Conversely, Fisman (2005) argued how urban life and social economic status can negatively affect students' environmental knowledge and awareness to their neighborhoods. Because of either a lack of natural settings to expose them to or an

increased fear of personal well-being, students residing in low-income neighborhoods where found to have more restricted access to their neighborhoods (Fisman, 2005). Programs aimed to help increase environmental awareness in an urban setting must therefore think of the role of the neighborhood by linking safety and security with ecological restorations (Fisman, 2005).

School gardens have also shown various degrees of effects on students. Dyg and Wistoft (2018) concluded that gardening helped promote not merely academic learning but interpersonal skills and empathy toward nature as well. The garden, as an educational setting, allows for working with the Earth while teaching students about patience and careful handling of the Earth between sowing and harvesting (Christodoulou & Korfiatis, 2018; Gadotti, 2010). After conducting an exploratory study of 310 middle schools in garden learning environments, Skinner and Uni (2012) concluded that it that students' engagement in the garden was showed positive correlations to their engagement in science class and their overall engagement in school as well as to their academic self-perceptions, including a sense of relatedness to school, perceived competence, intrinsic motivation, and autonomy orientation. Blair (2010) found conflicting results concluding that positive outcomes of science achievement and food behaviors resulted but they did not demonstrate improvements on environmental attitudes or social behaviors.

In conclusion, many studies have reported positive results when exposing students to outdoor activities, but complexations arise because of its inability to be packaged as a "one size fits all" approach in education. The consideration to the role of place and its local issues thus becomes a vital part of the developmental process of any EE program.

Effects of Exposure to Local Settings/Concerns

Wattchow and Brown (2011) stated that although empirical evidence is strongly lacking in place-based learning, the small number of important research studies can be used to guide educators through the complexity of place-oriented teaching and learning in the outdoor. Simsekli (2015) conducted a study with elementary students. During the intervention, students were exposed to EE on lessons for two hours a week for two weeks. Instead of focusing on global issues, concerns about their local lake were addressed. It was concluded that focusing on environmental concerns at the local level helps students increase engagement (Simseki, 2015). This is conclusive with Farmer, Knapp, and Benton's (2007) study of fourth grade students who visited Great Smoky Mountains National Park on a field trip. Evidence of the impact of students' environmental awareness after their emergence into their local ecosystems were still found a year after the study (Farmer, Knapp, & Benton, 2007). An increase in student motivation levels have also been reported when place based learning to solve local problems is embedded across subject areas (Askea, 2019; Goodlad & Leonard, 2018; Switzer, 2014).

Curriculum developed around a local compost project allows for lessons development that focuses on the flow of energy, sustainability, and the cycling of matter in ecosystems, pillars for ecological literacy. Minshew, Barber-Lester, Derry, and Anderson (2017) found positive results in sixth graders' cognitive understanding of the flow of energy and cycling of matter in an ecosystem after an eight-week composting unit of study. This is conclusive to the studies conducted with both early childhood students (Ashbrook, 2016) all the way to college participants (Bott & Cortus, 2014).

Overall, studies indicate that students are engaged and willing to work hard to solve problems at a local setting (James, 2016; Williams & Houseal, 2018). Widhalm (2011) furthered concluded that Capra's living systems approach to learning also provided an experience for students to feel quality of relating to the ecological principles of breath of life. Yet, topics about sustainability and conservation are often very polarizing in the educational field.

The Politics of Environmental Education

Negative connotations continue to surround the term "environmental education." In some sense, this is understandable because of the strong links one sees between EE and politics. Our environmental interactions are socially organized and a result of political processes (Henderson & Zarger, 2017; Hursh, Henderson, & Greenwood, 2015). People disagree about environmental issues and this transfers into how we conceptualize and contest such matters as the curriculum goals of EE (Hursh, Henderson, & Greenwood, 2015). Because EE is so often seen as a political issue, it is thus pushed far from the margins of school curricula by administrators and parents (Locke, Russo, & Montoya, 2013; Saylan & Blumstein, 2011). This is further complicated by the "dominant approaches within the informal and formal educational research literature" continuing to "pay scant attention to the political-ecological aspects of producing knowledge about the environment" (Henderson & Zarger, 2017, p. 286).

This polarizing view of EE, along with the ever-increasing pressures of standardized testing, continue to hinder forward progress for sustainability in public education environments. Conversely, Saylan and Blumstein (2011) reasoned that learning about sustainability should instead be considered a civic responsibility instead a political

one. Just as teaching people to follow the cultural and societal laws is considered a widespread practice both in the policies and the hidden curriculum teaching of every school in America, they postulate that teaching respect and responsibility for the finite resources of earth on which our lives collectively depend on is essential for our future society's success (Saylan & Blumstein, 2011).

Teachers play a big part in effective environmental practices, but many do not include ecopedagogy into their curriculum decisions. The notion that it is an "add on," its "lack of relevance to curriculum" and "too much other material to cover" were primary reasons why teachers did not implement EE into their classrooms (Ernst, 2009; Goleman, Bennett, & Barlow, 2012). This again suggests a conceptual barrier when viewing the environment as a content area, rather than as an integrating context or instructional method. Although there is the continuing apprehension, there appears to be growing grassroots movement for ecopedagogy amongst education professions. In a Yates's et al. study (2018) of 141 teachers and administrators, a strong level of agreement that EE is necessary and should be a part of teacher preparation programs was found. In order to combat some of these barriers, EE should be viewed as "not necessarily a unique subject area but a call to embrace the best practices in education such as integrated, learner centered, and experience-based approaches" (Burgess, 2010, p 3).

The assertion for embodied, situated and direct environmental learning experiences is a critical reminder that environmental problems are not just philosophical but also practical because people, through their daily interaction with the environment, are part of these issues (Payne, 1997). Therefore, an emphasis on "place" can impact students' ability to process the conceptual frameworks of ecoliteracy as well as fight off

political backlash. For instance, Sobel (2004) concluded that programs titled "cultural heritage" and "place-based" education often received much less resistance in educational settings. Saylan followed this by explaining that "environmentalism" should be abandoned and instead replaced with less polarizing terms such as "responsible citizenship" (as cited by Nijhuis, 2011, para. 22). Thus, abiding by these simply "word games", educators may avoid the political connotations otherwise associated with EE, while still impacting forward thinking.

Awareness and Engagement

Awareness is a relevant variable to consider when evaluating the effects of place-based EE programs on elementary aged students (Fisman, 2005). Although the concept of environmental awareness is intuitively clear for most people, a meta-analysis of scholarly literature by Ham, Horvat, and Mrčela (2016) concluded that there is no generally accepted definition. Also, other name variants, such as environmental awareness, environmental consciousness, and environmental concern, can further complicate a study (Ham, Mrčela, & Horvat, 2015). Culiberg and Rojsek's (2008) definition of environmental awareness will be used throughout this study because of its emphasis of relationships between an individuals' attitude and human behaviors. They define it as the predisposition to react to environmental issues in a certain manner; it is an element of one's own individual system of values and beliefs (Culiberg & Rojsek, 2008).

Environmental awareness as a measurable construct follows previous researchers leads as looking at it through a multidimensional lens; therefore, raising awareness must look to increase the level of environmental knowledge (cognitive component), promote personal attitudes toward solving environmental problems (emotional component), and

levels of participation in environmental activity (behavioral component) (Nazarenko & Kolesnik, 2018). Goodwin (2016) further connected affective and behavioral engagements by summarizing that "when a student can identify ecological concepts, but then also begin to ask questions of what comes next in action, then they are becoming ecologically literate" (p. 288).

As populations continue to rise, concerns with the reduction of available land and increased food demands requires humans to look at more efficient ways of feeding the masses. Globally, there is enough wasted food each year to feed nearly 2 billion people a 2,100 kcal/day diet (Kummu et al., 2012). It is reported that over 20-30% of food lost or wasted in the United States each year can be attributed to consumer behaviors. Furthermore, the US Dietary Guidelines Advisory Committee (2015) articulated the need for more research on the relationships between consumer behaviors, waste disposal, and sustainability practices to improve long-term food security. Ham, Mrčela, and Horvat (2015) concluded that environmental awareness is operationalized through the form of motivated pro-environmental behaviors. Therefore, it is imperative to understand motivational theory if positive behaviors are to be desired.

Self-Determination Theory

Ryan and Deci (2000) proclaimed that "The fact that human nature, phenotypically expressed, can be either active or passive, constructive or indolent, suggests more than mere dispositional differences and is a function of more than just biological endowments" (p. 68). Ryan and Deci thus orchestrated various experimental situations in search of a better understanding of conditions in which people's natural activity and constructiveness would flourish and those that would inhibit self-motivations

or social interactions. They concluded that individuals are inherently endowed with intrinsic motivational tendencies. Yet, these innate propensities require supportive conditions in order to maintain and enhance them, as well as careful avoidances from various non-supportive conditions (Ryan & Deci, 2000). Just as a plant requires water, sunshine, and minerals to thrive, Deci and Ryan (2000) suggested that autonomy, competence, and relatedness are essential for psychological growth, internalization, and well-being in an individual (as cited in Broeck, Ferris, Chang, & Rosen, 2016). While autonomy can be oversimplified to mean independence, it implies more that the action is needed with a sense of choice and volition, free from influences of others' wishes (Broeck, Ferris, Chang, & Rosen, 2016; Pass & Neu, 2014).

Through the development of the curriculum, one must then consider the complexities of the students it is intended to reach. Cognitive, social, and emotional needs must all be met for an effective learning environment to occur. With the assumption that people are naturally active organisms with tendencies toward growing, mastering challenges, and integrating new experiences into a coherent, well-rounded sense of self, Ryan and Deci's (2000) SDT helps this study ensure that social context is used to support the natural tendencies of individual's active engagement and psychological growth. Through this theoretical framework, it can be concluded that optimum performances will be achieved if the three basic psychological needs are met: *autonomy* (feeling a sense of volition), *competence* (to feel confidence and effective in whatever you are doing), and *relatedness (*to feel cared for by other and to feel like you belong in groups that are important to you) (Deci, 2017).

Pelletier et al. (1998) concluded that self-determined individuals will generally be more dissatisfied with the state of the environment, feel more competent to effect positive change, and are more engaged in activities to help solve the problem. This is consistent with the theory of Deci and Ryan. Therefore, findings like these should be considered as environmental programs are introduced. It would seem the focus should be not only on encouraging the public to behave in an environmentally conscious way but, more importantly, people should be motivated to do it for self-determined reasons in order to sustain the behavior for life (De Young et al., 1993). Pelletier et al. (1998) called for future research that foster self-determination toward environmental behaviors.

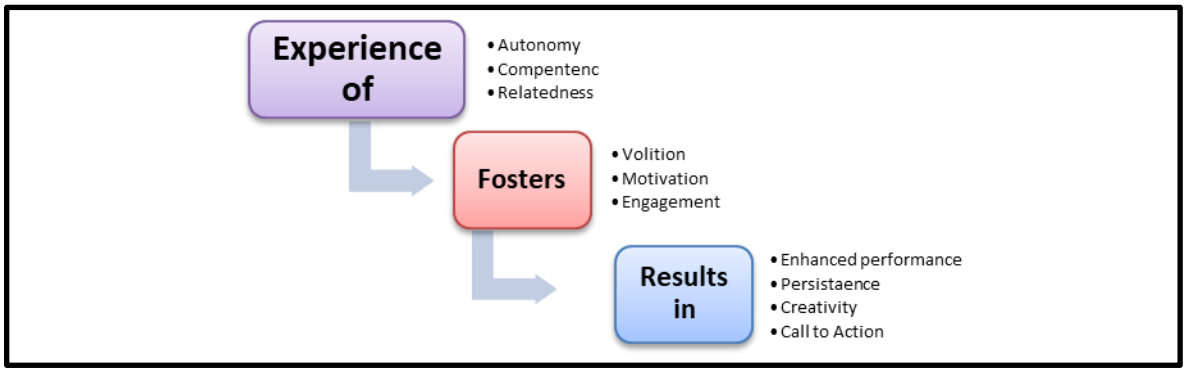

Figure 2.3. Ryan and Deci's Self-Determination Theory (SDT). Adapted from Intrinsic and extrinsic motivations: Classic definitions and new directions, by Ryan & Deci (2000). Contemporary Educational Psychology. 25:54-67.

Pelletier et al. (1998) concluded that "through the proper implementation of external contingencies, one could encourage people to participate in environmentally conscious activities" and if the "characteristics of the interpersonal environment are favorable, soon the process of internalization will take over and people will accept as their own motives that were originally foreign" (p. 462). It would eventually be the hope that external contingencies would no longer be necessary because engagement in

environmentally conscious activities would become self-determined as one transitioned away from more extrinsic forms of motivation toward intrinsic ones (Pellitier et al., 1998; Scott, Amel, Koger, & Manning, 2015).

Conclusion

Globally speaking, there is a growing consensus that the quest for sustainability is one of the major societal challenges of our times and that education has a vital role to play in tackling it (Van Poeck, König, & Wals, 2018). The process of fostering an ecologically literate citizenry is complex and not straightforward but it is undoubtedly a process in which educators are required to break away from traditional teaching and include more constructivist ideologies (Goodwin, 2016; Monaghan & Curthoys, 2008; Teisl & O'Brien, 2003). Ecological intelligence is inherently collective, and because school communities theoretically come alive through networks of relationships, they become ideal places to nurture ecological sensibility (Goleman, Bennett, & Barlow, 2012). Yet, despite the increasing support for sustainability education (Chawla, 2014; Wisconsin Dept. of Public Instruction, 2018) and improved knowledge frameworks of effective environmental action (Chawla, 2014; Simsekli, 2015), fostering ecoliteracy has been historically more difficult than anticipated (Monaghan & Curthoys, 2008; Wiek et al., 2013). This is conclusive with Goodwin's (2016) observations of common deficiency in ecological and systemic thinking amongst our society and educational institutions. Therefore, studies like this one are important as educators try to blend theory into practice in classroom settings.

Sanacore (2008) also emphasized the significance of this study by explaining that students are primarily emotional and secondarily intellectual. Thus, in order to improve

their interests in learning, students must be challenged, given choices, provided opportunities to increase their participation, and encouraged in a supportive environment (Sanacore, 2008). Knowledge of these theories, coupled with scholarly literature that suggests that educators should focus more on ensuring that students' psychological needs (i.e. relatedness, competence, and autonomy) are being satisfied in order to contribute to the quality effort levels in students (Grolnick, 2014; Marshik, Ashton, & Algina, 2017).

CHAPTER THREE

METHODOLOGY

Students at the local level appear to be ecoilliterate due to the lack of sustainable learning opportunities and lessons to empower student to become environmental stewards. Therefore, the problem of practice (PoP) was created: school practices are not nurturing an ecoliterate school community and the current conditions are further contributing to the global wasted food epidemic. This causes one to conclude that current curriculum practices are not effective in deepening scientific understanding of the effects these actions have on others. While Stone (2007) called for a need for future leaders who have learned to understand the complexity of the world and to think ecologically to solve our global issues, he concludes that education in many places are trending in the opposite direction, toward reduction and fragmentation due to overemphasis of standardized test scores.

Research Question

The research question for this study is "What impact will a place-based environmental education approach have on the environmental awareness level of 10 fourth grade students in a school located in a southeastern state?" Case study traditions were used to guide the coding, categorizing, and thematizing of data to promote a better understanding into the research questions and student perceptions during this environmental project-based inquiry unit (Durdella, 2018).

Statement of Purpose

The purpose of this study is to examine the impact that a place-based environmental education approach will have on the environmental awareness level of 10 fourth grade students in a school located in a southeastern state.

Action Research Design and Intervention

Students are often left out of the curriculum and instructional development conversations. This action research dissertation utilized the strengths of qualitative focus groups to allow students to voice their opinions about the place based composing unit and their perceived effectiveness in improving their environmental awareness. Exit slips with Likert scales and open-ended questions, classroom observations, and focus group semi-structured interviews were utilized to promote a better understanding of the constructs being studied. Through modeling ecoliterate behaviors in this experiential, place-based pedagogy, this unit, inspired by similar learning environments designed by Barlow, Marcellino, & Stone (2005), aims to do the following:

> instill a sense of place and of ownership, pride, and responsivity in students; teaching and practicing the principles of ecology; heightening children's environmental awareness and promoting Earth stewardship; and integrating subject matter such as science, math, and social studies. (p. 153)

Cincera and Krajhanzl (2013) attributed this gap in practice to the lack of understanding of instructional strategies for development action competence for sustainability in the formal education environment. Findings from Anderson's (2018) study indicate that textbooks provide little guidance to educators on how to implement action-based and task-based learning in teaching pupils about sustainability. Most EE,

like much of education, often fails to recognize the critical role that emotions play in the learning process (Michael, 2005). This study, guided by the principles within SDT (Ryan & Deci, 2000) and the core concepts that describe patterns and processes by which nature sustains life (Capra, 2005), tried to look for effectiveness on student awareness as it seeks new ways to reverse these negative trends of affective neglect in education. Thus, all curriculum and instruction decisions were inspired by Goleman, Bennett, and Barlow's (2012) notion that "socially and emotionally engaged ecoliteracy leads to deeply meaningful, inspiring, and effective education" (p. 2).

Many reports which highlight the necessity for changes towards "more sustainable lifestyles and acknowledge the role of education in achieving this have failed to specify how schools can contribute to such changes" (Tilbury, 1993, para. 2). Being a part of an action research study requires one to utilize their local perspective to generate new, transferable knowledge that can be used to improve other settings (Herr & Anderson, 2015). It is a place-based study that requires the insider to carefully and systematically reflect throughout the process. It focuses on both the action, such as improvement of practices, social change, etc., and research to create valid knowledge about social practice (Herr & Anderson, 2015) in the hopes of improving education. Darling-Hammond (2009) called for a need for teachers to develop "thinking curriculum" as a way to advance learning in our schools today, one that moves away from lower order "rote" skills like memorizing and conducting simper operations to one in which students are exposed to independent analysis and problem solving, extensive research, and strategies for accessing and using resources in new situations. Although she calls for these changes in educational standards to overcome the inequalities found in our current

educational systems, she further explains that changes toward a more rigorous curriculum would benefit all students in the classroom (Darling-Hammond, 2009).

After pursuing the STEM AdvancED Accreditation to provide best practices to its student population and remain relevant in the Choice School debate, Southeast Elementary actively sought ways to provide meaningful opportunities to learn through an integrated STEM curriculum. The philosophy is that the entire student population should be involved in STEM learning, including students from underrepresented groups. Therefore, all students participate STEM activities in a six-day Related Arts rotation. Teachers should also expose students to STEM lessons but extreme pressures to teach to the standards for the purposes of standardized testing and the higher stakes attached to the scores has drastically reduced the science block and have made it difficult to get teachers committed to changing up their curriculum. This is conclusive to other studies where many teachers reported that feeling overwhelmed by standards and busy schedule are reasons why they do not fit sustainability into their curriculum (Redman, 2013).

These new pressures at the local level created by new *Read to Succeed* legislature passed in 2015, which requires a third grader to be retained "if the student fails to demonstrate reading proficiency at the end of third grade as indicated by scoring at the lowest achievement level on the state summative reading assessment SC READY" (S.C. Department of Education, 2018), require educators to look for new ways to implement science throughout the day because the tradition block continues to shrink. As STEM committee chair, it is imperative that practicality of an interdisciplinary unit and its effectiveness on student motivation and engagement is evaluated before presenting to the staff. Redman (2013) further confirmed the necessity of studies like this to overcome the

barriers of standards and subjects when he concluded that "explicitly linking sustainability curriculum to standard subjects, expected knowledge and skills will help teachers integrate sustainability into their classroom" (p. 12). This action research, thus, intended to utilize this study to explore both effectiveness of intervention on solving the local PoP and evaluation of practicality of including outdoor learning across subject areas for emotionally and socially engaged ecoliteracy.

Setting and Time Frame of Study

Research Site

Southeast Elementary School, a pseudonym to protect privacy, is in a semi-rural town in the South. Current enrollment at the school is 622 students: 53% male and 47% female. Concerning ethnicity, 60% classified as white, 18% are Hispanic or Latino, 14% are African American, 4% identify as multi-racial, and 3% are Asian. Thirty-four percent of the population receives free or reduced lunches.

Timeline

In the Spring of 2019, the students and teacher-participants embarked on a journey of discovery into the effectiveness of school practices for change on student's environmental awareness regarding wasted food in this country. Inspired by Capra's notion that EE must include lessons for action for sustainable societies, over the course of the seven-lesson intervention, all students in fourth grade began tracking their cafeteria waste, brainstormed and implemented strategies to reduce waste, and participated in inquiry based composting lessons. Capra (2007) postulated that human communities should be modeled after nature's ecosystems, which are sustainable communities of plants, animals, and microorganisms. Therefore, time was allotted to observe, appreciate,

and learn from the sustainability concepts of nested systems and cycles that allow nature to support life.

- One week before the intervention: All students during the last 10 minutes of the fourth-grade lunch block recorded the number of items they were throwing away daily. Recording sheets were categorically listed so students could show a distinction between which items were plastic, Styrofoam, paper, and food. Furthermore, home lunch and cafeteria lunches were compared. This information was then added to an overall chart for analysis of overall trends.
- Seven-lesson place-based ecoliteracy unit on waste reduction in the cafeteria (See Appendix B): All students participated in actively strengthening their socially and emotionally engaged ecoliteracy skills through an interdisciplinary unit in the STEM Lab. Every 6-day rotation, students worked on outdoor exploration and data collection to generate new knowledge on composting and foster a connectedness to nature. Because Nazarenko and Kolesnik (2018) associate environmental awareness with cognitive, emotional, and behavioral components, various measuring tools were used to assess the multidimensional aspect of the concept. A post-intervention measurement of cafeteria waste was used to evaluate ecoliteracy unit on overall sustainable behavioral practices. Classroom observations, surveys, and interviews were utilized to attempt to measure cognitive and affective changes in the individuals.

Student-Participants

Qualitative research focuses on understanding the intervention or phenomenon and exploring questions like ‘‘why was this effective or not?’’ and ‘‘how is this helpful

for learning?'' (Sargeant, 2012). When selecting participants in a qualitative research study, it then must be purposeful because they play such an important role in finding relationships and understanding in a phenomenon; participants need to be chosen to help the researcher enhance an understanding of the problem being researched (LaMorte, 2016). Fourth grade was selected because of its uniqueness in being the only elementary grade still required to take the science state standardized test. Teachers at this level may feel added pressures of preparing students for a test and, based on previous studies, be most apprehensive to including sustainability lessons into their curriculum.

In qualitative research, there is no predetermined number that is required for strength in the data (Sargeant, 2012). The number of participants is decided based on the number necessary in order to better understand all important elements of the phenomenon being studied (Sargeant, 2012). For this action research study, a 10-student sampling size was utilized to develop deep analysis opportunities. Although all students will be required to reflect and evaluate lessons, only the 10 fourth grade students, generated by a stratified sampling strategy, will be analyzed.

Each student, preschool through fifth grade, meets with the teacher-researcher in the STEM Lab once every six days in a Specials rotation. During this time, this class exposes students to the engineering, robotic, gardening and experimental experiences that regular classroom teachers might find difficult to implement. Although, some teachers have expressed interest in producing more interdisciplinary units where STEM is more of a focus within their own lessons, overall apprehension and anxiety is expressed by most, because little training and information has been provided to the staff after the accreditation process. Through this action research, it looks for effective and meaningful

methods to share with the staff to make a more cohesive STEM experience for the student population.

All Southeast Elementary students in fourth grade participated in the study in the Spring of 2019. A qualitative research framework was used to assess the interventions effectiveness in affecting student environmental awareness and ecoliteracy during a place-based composting unit. Within each class period during the 6-day Related Arts rotation, lessons guided by the principles of Goleman, Bennett, and Barlow's (2012) socially and emotionally engaged ecoliteracy practices were implemented to measure its effects on student environmental awareness. Triangulation of data occur by using four different types of data collection. Using multiple data sources can enhance the inquiry as it allows for us to gain different perspectives from different strategies (Dana & Yendol-Hoppey, 2014). Employing multiple strategies can also build a strong case for the findings by pointing out the ways different data sources led to the same conclusions (Dana & Yendol-Hoppey, 2014).

Table 3.1

Fourth Grade Demographics

	Total	Male	Female	Hispanic	A.A.	Caucasian	Free & Reduced	Resource
Study Sample	10	3	7	3	2	5	4	1

To protect the safety and confidentiality of the students and the school, pseudonyms where utilized throughout the study. Ten students, with their pseudonyms, are described below to strengthen the overall validity of the study:

- **Student 1: Clara** is a friendly African American female with a reserved personality. Prior to the intervention, she did not actively participate in class discussions.
- **Student 2: Ben** is a very active, outgoing Caucasian male who tries to get out of doing schoolwork as much as possible. He appears to get along well with his friends and often is seen joking with them during class time.
- **Student 3: Annie** is a Caucasian female who just moved in from another state at the beginning of the school year. Her outgoing and positive attitude appear to help her fit in with the other students in class.
- **Student 4: Kimberly** is an outgoing Caucasian female. She loves to sing and perform on stage. She often actively participated to class activities throughout the school year.
- **Student 5: James** is an African American male. He is respectful but reserved in his demeanor during class activities.
- **Student 6: Daphne** is a Hispanic female. She is very reserved and has openly talked about not being the "outdoorsy" type.
- **Student 7: Samantha** is a Hispanic female who has a very artistic personality.
- **Student 8: Ethan** is a Caucasian male. His personality can be described as outgoing and active. He often is found joking during class time.
- **Student 9: Megan** is a reserved Caucasian female who competes on a competitive cheerleading squad. She has openly talked about how she is not the "outdoorsy" type and does not like getting dirty.

- **Student 10: Maggie** is a Caucasian female appears to have a shy but sweet spirit to her. She is a conscientious student who appears to enjoy school.

Ethical Considerations

Lincoln (1995) addressed the need for qualitative research to be described as communitarian because of the "desire of those who discuss such research to have it serve the purposes of the community in which it was carried out, rather than simply serving the community of knowledge producers and policymakers" (p. 275). This, therefore, includes the need of researchers to follow ethical guidelines that protect the participants during the study. Confidentiality of research data will be strictly adhered to by assigning a pseudonym to each of the participates. Because younger students are more vulnerable in some respects and have fewer legal rights, informed consent of legal guardians must be collected (Fraenkel, Wallen, & Hyun, 2012) (See Appendix A). All guardians consented to the 10 students in the focus group. Assent forms (See Appendix B) were also created and then explained to the student participants to ensure that they understood the study. Furthermore, it was clarified to them that participation was strictly voluntary and can drop out of the study at and time without consequence to their overall STEM Lab grade. All students agreed to participate.

Research Methods

Capra (2007) emphasized that taking a close study into the processes by which nature sustains life teaches us that sustainable systems are possible "and that nature is both our model and our mentor" (p. 18). Therefore, time during this unit was utilized to step outside of the classroom and learn from the environment on the school grounds. After students explored the school grounds to understand the cycles that exist in the forest

for sustainability, students were asked to examine their own actions, specifically through quantifying the waste generated in the cafeteria. Then, students were asked to analyze the data collected over the five-day period and construct solutions for source reduction into local landfill.

During the development of an empowering place-based unit of study, the goal of holistic student growth in both cognitive and affective domains helped guide the decisions in intervention objectives and overall measuring tools. Qualitative research was selected specifically because of its purpose to facilitate the voice of a local group in the hopes of improving conditions (Durbella, 2018). Using this form of dissertation research allows for students to voice their opinions in a safe, open environment. As this study is guided by a constructivist paradigm, it looks to an understanding of functionality within the context and setting with an understanding that external validity will be weakened. Qualitative inquiry does not seek to generalize from their small population but rather looks for transferability across context (Durbella, 2018). That is why a strong foundation of the constructs and methodologies must be laid out to strengthen the trustworthiness, or internal validity, of this study.

These frameworks help provide the structure when trying to define the philosophical, epistemological, methodological and analytical approaches to the dissertation as a whole (Grant & Osanloo, 2014). Therefore, qualitative research methods were selected because of the abstract nature of engagement. Because Ryan and Deci's SDT concluded that engagement is often inadvertently interwoven within an individuals' motivational and metacognitive levels of understanding, it can best be explored through searching for relationships that lie within systems and utilize inquiry to promote

understanding rather than to explain it (Stake, 1995). Because constructivist ideologies concluded that it is necessary for students to actively participate in the learning process, student-centered activities were interwoven into all the curriculum and instruction decisions. Berry (2005) emphasized the necessity to equip children with the skills to successful look beyond "problems" to the patterns that connect them. Further decisions regarding the curriculum and instruction in this food reduction unit also were highly influenced by Ryan and Deci's (2000) SDT which suggested that students' competence, autonomy, and relatedness levels must be addressed if motivation is sought for future action. Because sustainability relies on continuing action for change across settings and time frames, high levels of motivation must be instilled in the students to develop and maintain stewardship.

Data Collection Measures, Instruments, and Tools

An exploratory case study format looks to gain knowledge by creating data collection methods that provide enough data so that it can be effectively analyzed to uncover patterns. During the intervention study, a variety of data collecting methods were implemented to strengthen the trustworthiness of the study. Data collection occurred during the Spring of 2019. Because environmental awareness is a complex construct, various data collection tools were utilized to try to measure the unit's effects on observable and internal levels of motivation and engagement in the context of the local setting. The *Environmental Awareness Survey* was used to measure students' attitudes and perceptions of environmental issues and calls for action. Exit slips with open-ended responses and Likert scales helped triangulate the data for a better picture of effects of the intervention. Field notes and teacher reflective journaling were also coded for behavioral

engagement levels. Finally, entries in the students' nature journals and conversations during semi-structured interviews helped provide essential information on student's own self perceived effects of the unit on their ecoliteracy.

Table 3.2

Classroom Composting Matrix

Research Question:	Tools for Measuring Internal Awareness Levels	Tools for Measuring Observable Awareness Levels
R1: What impact will a place based environmental education approach have on the ecoliteracy level of 4th grade students in a school located in a southeastern state?	• Environmental Awareness Survey • Exit slips w/ open ended responses and Likert scales at the end of the ecoliteracy lesson • Semi-structured interviews • Student Nature Journals	• Field Notes • Teacher Reflective journaling • Behavior Charts • Student Nature Journals • Cafeteria data

Environmental Awareness Survey

Environmental awareness, as defined as the "knowing of the impact of human behavior on the environment," has both cognitive, knowledge-based components as well as affective, perception-based ones (Kollmuss & Agyeman, 2002, p.253). This was conclusive with Ryan and Deci's (2000) self-determination theory which accentuated the importance of focusing on the emotional needs of individuals for engagement. Therefore, multidimensional aspect of these concept cannot be ignored. That is why questions regarding the three different domains were included in the measuring instrument for this study (see Appendix C). Although cognitive awareness of environmental issues is a precondition for action for the environment (Ayaydin et al., 2018), it is also important to

understand the necessity of including meaningful reflection on the affective awareness possessed towards the environment to develop environmentally conscious behaviors as behavioral changes for ecoliteracy objectives (Artvinli & Demir, 2018). While environmental attitudes where proposed to bridge the gap between an individual's environmental knowledge and call to action (Pelletier, 1998), they can be difficult to measure. This is especially true in younger students. Many researchers focused more on developing instrument tools in the middle or high school setting (Artvinli & Demir, 2018) than at the elementary school age. Therefore, a synthesis of three different previously validated instrument tools was utilized to fit the context of the local setting and complexity of environmental awareness in an individual:

- *Bogner's (2018) Environmental Values Scale (2-MEV)*: Previous studies reported high levels of reliability in measuring environmental values in participants with reported Cronbach's alphas ranging between .71 and .94 (Boeve-de Pauw & Petegem, 2017).
- *Artvinli and Demir's (2018) Environmental Attitude Scale for Primary School Students:* Only questions will a Cronbach's alpha of .70 or higher were admitted into the study instrument tool.
- *Navarro, Olivos, and Fleury-Bahi's, (2017) Connectedness to Nature (CNS)*: This Lickert-types scale reported strong validity when measuring adolescent connectivity to nature with an alpha score of .92 (Boeve-de Pauw & Petegem, 2017).

Likert scales (5= Strongly Agree and 1= Strong Disagree) were implemented to help measure the value of how the student felt about the given statements regarding cognitive

and affective domains. *Never, Sometimes, and Always* were used to answer questions regarding environmental behaviors.

Table 3.3

Components of the Environmental Awareness Survey

3 Main Domains of Awareness:	*Definition of Domain and Example:*
Cognitive Component	Questions measure the level of knowledge of environmental issues. *Ex: All living things (micro-organisms, plants, animals, and humans) rely on one another.*
Affective Component	Level of emotion and attitude that the students report of nature and environmental education *Ex: It's not worth me doing things to help the environment if others don't do the same.*
Behavioral Component	Student perceived levels of action in environmental issues *Ex: If I have leftover food after the lunch period, I save it to eat later.*

Lunch Log for Quantifying Waste

For five days prior to intervention, students were asked to log in the amount of waste items by category. Students categorized their waste by counted how many items of food, plastic, Styrofoam, and paper are thrown away and then recorded their data on their worksheet (See Appendix G). This helped quantify how much waste in pounds was being thrown away during the fourth-grade block and helped provide data to analyze for trends. Baseline data will then be compared to post intervention data collected the week after composting unit is complete. Bulletin boards were also utilized to track changes and empower individuals to make more sustainable choices in the cafeteria.

Semi-Structured Interview (See Appendix H)

Student Interview Protocol was followed during the interviews with students. Merriam (1998) explained that formatting an interview in a semi-structured format allows for the researcher to "respond to the situation at hand, to the emerging worldview of the respondent, and to new ideas on the topic" (p.74). In qualitative research, these types of interviews are often best administered toward the end of a study, as they tend to shape responses to the researcher's perceptions of how things are (Fraenkel, Wallen, & Hyun, 2009). Therefore, these were conducted during the week of the 7th lesson in the intervention study. Because similar questions for the interview are also found on Environmental Awareness Questionnaire, which is given as a pre- and post-intervention measuring tool, patterns in the data across instruments were coded using coding priori methods for intervention effects.

Field Notes with On Task/Off Task Behavior Chart (See Appendix I).

Efron and Ravid (2013) emphasized the need for carefully constructed field notes during observations by stating that "the richer the description the more meaningful the observation" as thick description narratives bring the setting to life for the reader (p. 88). Notes, both during and directly after the class, were writtien chronologically in one journal. On-task behaviors and student comments both during small and whole group discussions were recorded on the worksheet (See Appendix I).

Student Work in Nature Journal (See Appendix F)

Nature journals were created during the first lesson of this unit and then used throughout the unit to both document the learning and help students self-evaluate the effectiveness each lesson had on impacting their connectedness to nature. These journals

were made with a conscious effort to reflect the ecoliteracy skills this unit was seeking to develop. For example, during the first class, the intervention sought to help first students find a connection and appreciation to their local environment. Therefore, at the end of the lesson, students all sought out a stick that would help bind their journals together and brought it back into the classroom. Then, they repurposed the precut pieces of cardboard that would have otherwise been thrown away from the school as the covers. Students utilized the blank pages to either artistically draw something they saw in the outdoor lesson or collect their natural "treasures" such as leaves or a feather they found. Exit slips with lines for a written response along with Likert scales were also embedded into the journal and were utilized to assist in measuring students' self-perceived effectiveness of the lesson on their environmental awareness levels.

Nature Journal's Exit Slips with Open Ended Questions and Likert Scale (See Appendix F)

Exit slips (See Appendix F) were also embedded in between the nature journals' blank pages and were utilized to assist in measuring student environmental awareness levels. Specifically, at the end of each ecoliteracy intervention, students were provided ten minutes to reflect on the lesson. Exit slips, located within the pages of their nature journal, utilized Lickert scales and open-ended questions (See Appendix F) to help evaluate the students' overall attitudes and perceived levels of effectiveness. Likert scales helped assist the elementary students in expressing their opinions on the lessons. Short answer responses were also used to gain a deeper understanding into the self-perceived needs of the students and how they thought the intervention effected their environmental awareness.

Table 3.4

Components of End of the Class Exit Slip

Evaluation of Ecoliteracy Lesson a Likert Scale:	*Open Ended Responses:*
How did you like today's lesson? *1= Hated it! to 10= Loved it!*	Tell me about the lesson today.
Did today's lesson make you feel more connected to nature? *1=Definitely No to 5= Definitely Yes*	

Procedure

The procedure was guided by the principles in Capra's Ecoliteracy, a seven-lesson interdisciplinary intervention unit (See Appendix C) created to strengthen students' emotional and social connections with nature. Standards and ecological literacy principles were aligned to demonstrate the possibility of still fostering a connectedness to nature in a standardized driven classroom (See Appendix D). Real world examples and outdoor exploration, as inspired by constructivist ideologies, allowed students to construct their own ideas of sustainability practices. Place-based learning pedagogy encouraged student-centered experiences and opportunities for connectedness to their local setting as they constructed an action plan for school wide composting.

Table 3.5

Overall Timeline and Objectives for Place-Based Unit in Waste Reduction

50 Min. Lesson	**Overall Lesson Objective:**	**Measurement tool:**
1 Week Prior to Unit	<u>*Pre-assessments:*</u> SW complete *Environmental Awareness Surveys* as baseline data before intervention begins. SW also quantify cafeteria waste by completing the *Waste Log* every day for 5 days. Cafeteria waste for the fourth-grade lunch block will also be weighed in pounds for post-intervention data to compare with pre-intervention data.	***Environmental Awareness Survey** ***Cafeteria Waste Log**

Lesson 1	*What is ecoliteracy? How can I be a more ecoliterate person?* *Lesson seeks to activate the social and emotional ecoliteracy levels in the students by introducing them to the idea of nested systems and enlighten them on their role they play in a complex, interconnected universe. Outdoor exploration will also be used to attempt to connect students to nature and influence their appreciation of it.*	***Exit Slip** ***Student Artifacts** *** Teacher Reflective Journal** ***Field Notes**
Lesson 2	*What is ecoliteracy? How can I be a more ecoliterate person?* *In this lesson, activities seek to increase student's understanding of the cycles that sustain life in nature. Outdoor exploration in the trees in the back of the school property will be utilized to bring lessons in the book to life.*	***Exit Slip** ***Student Artifacts in Student Nature Journal** *** Teacher Reflective Journal** ***Field Notes**
Lesson 3	*What is ecoliteracy? How can I be a more ecoliterate person?* *In this lesson, students will understand the impacts that their actions have on the overall cafeteria waste by charting and evaluating their lunch waste. Overall trends will be studied, followed by brainstorming what should be done.*	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**
Lesson 4	*What is ecoliteracy? How can I be a more ecoliterate person?* *In this lesson, students will understand ecoliterate behaviors found across the country and brainstorm ways in which students can act in the local setting*	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**
Lesson 5	*Vermicomposting & Continued Experiment Data Collection* *Lesson will introduce students to the wonders of decomposers. Hands on exploration in the classroom will help students understand the physical characteristics that help worms survive and learn about the vital role they play in a sustainable "zero waste" lifestyle.* *A Second outdoor compost pile will be set up and PH levels and temperatures recorded daily over the next four weeks.*	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**
Lesson 6	*Classification of Plants, Plant Needs & Continued Experiment Data Collection* *Students will be exposed to the effects that compost has on the growth and health of a plant. Student should understand the overarching theme at the end of the lesson: A lack of nutrients may make plants and/or animals experience stunted growth and make them vulnerable to sickness. Lesson should expose students to the benefits of composting (waste reduction for landfills and adding nutrients to the soil).* *As they are searching for indications of healthy vs. sick plants, students will use what they know about leaves (pinnate vs. palmate) and shapes of flowers to classify the plants in the school garden. Students will also discover the interdependence that exists between our flowering plants and pollinators in the animal kingdom.*	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**

Lesson 7	<u>*Connectedness to Nature*</u> *Lesson objectives look to help students summarize their growth during the socially and emotionally engaging ecoliteracy unit. SW utilize the lessons over the unit and the natural surroundings to create haikus or personification poetry.*	***Student interviews will occur in the morning during the week of Lesson 7.** ***Student Nature Journals**
1 Week after intervention	SW complete *Environmental Awareness Surveys* as measurement tool for intervention on students' environmental awareness and ecoliteracy levels. SW also quantify cafeteria waste by completing the *Waste Log* every day for 5 days. Cafeteria waste for the fourth-grade lunch block will also be weighed in pounds for post-intervention data to compare with pre-intervention data. SW continue monitoring the compost piles after the intervention. SW also continue to measure PH and temperatures to recognize when bacteria actively working in the pile.	***Environmental Awareness Survey** ***Cafeteria Waste Log**

Data Analysis

Within qualitative research, two main strategies increase rigor and quality of the research: ensuring authenticity of data and trustworthiness of the analysis (Sargeant, 2012). As data was collected throughout the course of the seven-lesson ecoliteracy unit of intervention, analysis was conducted concurrently with data collection. Miles, Huberman, and Saldaňa (2014) concluded that this ongoing, interwoven data collection and analysis from the start would allow for a healthy corrective for build-in blind spots. Therefore, exit Slips, informal interviews, student nature journals, and teacher reflective journals were code analyzed for adjustments to future lessons. Interviews and pre- and post-intervention surveys were evaluated at the end of the seven lessons for overall patterns.

Because qualitative studies implore the local case to explore a broader phenomenon, coding analysis was implemented throughout the study. Codes are the prompts in the data used for deeper reflection of the meanings of the information obtained during a study. Coding is then the heuristic task of condensing the data into chunks that are readily analyzable units (Mills, Huberman, & Saldaňa, 2014). Specifically, In Vivo coding methods was used during analysis of interviewing and short answer responses. In this type of system, quotation marks were used to differentiate

participants' voice from those of researcher-generated codes. Because this critical study was looking to facilitate the voice of the students, this was a necessary system; it prioritized and honored the participants' expressions.

Qualitative case studies are limited by the integrity of the investigator and final reports are created through the investigators own instincts and abilities (Merriam, 2009). Limitations further affect the generalizability of these findings. This action research does not seek to find transferability but to find solutions to problems at the local level. After the first cycle of data was coded, these trends were sought out throughout the study utilizing an analytic memo. Mills, Huberman, and Saldaňa (2014) defined these as the ongoing reflection and thinking processes of the data used to not only describe summaries but attempt to synthesize the data into higher level analytic meanings.

Table 3.6

Schedule for Data Measurements and Analysis

Type of Measurement Tool:	*When Will It Be Administered?*	*When Will It Be Analyzed?*
Cafeteria Waste Log	1 Week before intervention;	Initial data was analyzed during Lesson 3
Environmental Awareness Survey	One week before intervention and one week after intervention	Analysis was completed by comparing the 10 students answers in pre- and post-surveys one week after intervention is complete.
Connectedness to Nature Survey (CNS):	One week before intervention and one week after intervention	Analysis was completed by comparing the 10 students answers in pre- and post-surveys one week after intervention is complete.
Exit Slips	At the end of lesson 1-7	Inductive coding methods was concurrently evaluated as data was being collected help shape intervention

Student Nature Journals	At the end of each class period	Inductive coding occurred concurrently as data was being collected during the study to help shape intervention
Teacher Reflective Journal	Daily for conversations with morning After each lesson	Inductive coding was occurring concurrently as data is being collected during the study to help shape intervention
Field Notes	During the lesson and after each class period	Inductive coding was occurring concurrently as data is being collected during the study to help shape intervention
Semi-Structured Interview	10 minutes in the morning during the week of Lesson 7	Inductive coding was occurring after all 10 students have been interviewed.

Triangulation of data is required as data is collected and prepared for coding analysis. Quality criteria in qualitative research requires the researcher to understand the necessity of developing strong credibility during the methodologies portion of an action research. This is the level of trustworthiness and plausibility of the research findings. Triangulation of data and rich descriptions of events and researcher's positionality strengthen a qualitative study (Taylor, 2010). This study thus utilized surveys, open ended exit slips, Likert scales, semi-structured interviews, samples of student classwork, and field notes to better understand the effects of ecoliteracy activities on student environmental awareness.

Merriam (2009) concluded that qualitative case studies' focus stems from the researcher's interest into gaining a deeper insight, discovery, and interpretation rather than hypothesis testing. Because engagement and motivation levels are highly connected

to internal behaviors, surveys, Likert scales, short answer responses, and semi-structured interviews were implemented to triangulate data to better understand students and environmental awareness levels.

Reflection with Participants

The teacher-researcher and student participants debriefed on the findings after this study in a whole group setting. The entire research process was explained, and results were discussed with ambiguity to protect the privacy of the individuals. Student feedback was requested to gain insight for future studies. By allowing this opportunity for reflection with the participants, a better retrospective examination of the various logistical aspects of the action research study was conducted (Mertler, 2014).

Plan for Devising an Action Plan

After a careful analysis of the data, the teacher-researcher developed an action plan that included recommendations for future lessons. A professional development session was created to share the findings with the rest of Southeast Elementary. Staff members underutilize the school grounds so it can be postulated that with training and increased knowledge of the impacts that place-based pedagogy had on environmental awareness and student engagement, they might be more encouraged to implement similar practices in their classroom.

Mertler (2014) articulated the importance of the development of an action plan at the end of the research because it essentially puts the "*action* into *action* research" (p. 220). If done properly, it allows for effective teaching practices to evolve from the findings of the study. Yet, the cyclical nature of action research in education alludes to the necessity to look at the methods and results through a critical eye. Furthermore,

results should be shared so that interventions can be tested across a variety of settings and participants in future studies.

CHAPTER FOUR

FINDINGS FROM THE DATA ANALYSIS

This study examined the impact that a place-based food waste reduction unit of instruction would have the overall environmental awareness levels in 10 fourth grade participants at Southeast Elementary School. The identified PoP for this study was that students seemed to have a disconnection with their environment. Ecoilliterate behaviors at the local level further signaled deficiencies in current curriculum toward sustainability. This, coupled with teachers' concern over insufficient content time, has led this action researcher to explore interdisciplinary curriculum development to combat current local problems.

Over a 10-week period of data collection, from March 13, 2019 through May 22, 2019, students were exposed to the eight-lesson unit of instruction every six school days. This resulted from having to conduct the study during a six-day rotating related arts schedule. Extra time in the lab, from 10:00-10:10 a.m., was provided after each intervention to allow amble time for students for careful completion of their journal reflections and exit slips. The teacher-researcher recorded field notes and behavioral charts were completed immediately after school on each day of the intervention. In addition, during morning routines to maintain the compost bins, the teacher-researcher and volunteered student participants often had informal conversations. These were also transcribed daily for future analysis. Environmental Awareness Surveys were administered both before and after the seven-lesson place-based unit of instruction to help

find effects. Lastly, student participant interviews were administered and coded during the last week of the intervention. Each student met with the teacher individually for ten minutes to allow them the opportunity to share their experiences and insights. Finding were first described, followed by emerging themes, to help accurately answer the research question.

Research Question

What impact will a place-based environmental education approach have on the environmental awareness level of fourth grade students in a school located in a southeastern state?

Purpose of the Study

The purpose of this study was to examine the impact that a place-based environmental education approach had on the environmental awareness level of fourth grade students in a school located in a southeastern state.

Findings of the Study

Because raising awareness was the goal of the intervention, triangulation of a various measuring tools was conducted in order to properly evaluate the multidimensional aspect of this concept. Methodologies and the data analysis choices were all viewed in terms of environmental awareness as a hybrid of individuals' personal level of environmental knowledge (cognitive component), personal attitudes toward solving environmental problems (emotional component), and levels of participation in environmental activity (behavioral component) (Nazarenko & Kolesnik, 2018). In the next section, descriptions of the individual data sources were first discussed to lay the foundation for the presentation of the overarching themes that emerged. Much of the

data was presented in a narrative format with the intention of helping strengthen the internal validity of this qualitative research study.

To complete the data analysis of this action research study, the field notes and teacher reflections were first examined immediately following each lesson to identify key themes that were developing regarding the content and structure of the place-based ecoliteracy lessons and objectives in the classroom. At the same time, exit slips (See Appendix F) were also routinely cross analyzed to compare the teacher researcher's observations with the students' self-reported enjoyment and connectedness to nature levels. During the end of the intervention, transcripts from the student participant interviews were then coded through In Vivo methodologies to assess their perceptions of effectiveness of ecoliteracy in the classroom. Through this method of breaking down the data into distinct ideas, exact words or phrases of the participant served as a code. Such codes help anchor the analysis in the research participants' world by offering clues about the "relative congruence between interpretations of participants' meanings and actions and their overt statements and actions" (Charmaz, 2014, p. 57). Finally, the pre- and post-intervention questionnaire data was compared to see if suggested themes that emerged through conversational and behavioral indicators from the other three instruments were also supported when quantifying the student's environmental awareness with the five-point Likert scales (See Appendix E).

This process of data analysis was first conducted on each individual data set, followed by a synthesis of the findings in which three themes distinctly emerged (see page 114). The teacher researcher used both a priori codes (based on existing literature) to categorize the dense data into the three domains of environmental awareness and

inductive codes (derived from new knowledge) to uncover emerging themes. In the first stages of analyzing, each set was studied separately. Conversations both in class, during interviews, and within student written responses were openly analyzed line-by-line through In Vivo methodologies to generate categories from the language of the students. Predetermined codes derived from related literature on the three domains of environmental awareness helped organize the data and more organically allowed themes to emerge. The teacher researcher created maps of major codes, categories, and any connections between them. As the study progressed, data was organized by revisiting each independent instrument and remapping new understanding with emerging themes. During the organizational data review, memos were used to reflect on any newly gained insight and to eventually clarify the research conclusions.

Overall Results of Environmental Awareness Survey

To determine the impact of the place-based unit on students' environmental awareness, student participants were surveyed using five-point Likert scales to assess their self-perceived levels of environmental awareness and connectedness to nature. The teacher-researcher utilized a pre- and post-survey analysis to study the change in students' cognitive, emotional, and behavioral domains over the 10-week unit. Averages were made after each survey by adding up and then dividing the numerical selection for all 10 fourth grade participants. Then, the differences were calculated and recorded for intervention effects in each one of the categories.

Results from the survey (See Figures 4.1- 4.4) indicated that experiences with composting and outdoor learning improved overall student knowledge of decomposers and composting processes, increased overall connectedness to nature, and impacted self-

reported behavioral changes in select categories. This was evident in both their responses to the questions as well as their ability to understand the content of the instrument. For instance, to administer the pre-intervention survey, frequent questions and clarifications were needed for many of the questions as the teacher researcher verbally administered the material. By the end of the study, concepts of connectedness and interdependency became much easier to comprehend.

Connectedness Component of Survey (See Appendix E)

Connectedness to nature is usually affectively explained. It is often operatively defined as a self-perceived relationship of interconnection between the self and the natural world; it reflects a sensation of kinship and an affective individual experience of connection with nature (Otto & Pensini, 2017; Mayer & Frantz, 2004). Questions in this session, therefore, were worded in such a way that it asked students to assess their feeling of belonging in nature. Evaluation of the student responses in the pre- and post-surveys showed this increase in relatedness between themselves and the outdoor setting after the 10-week study.

Following the place-based ecoliteracy unit, students now overwhelmingly concluded that they feel a part of the outdoors. For example, questions such as, *I often feel a sense of oneness with the natural world around me* and *I think of the natural world as a community to which I belong*, were not positively responded to until after the intervention was over. With the idea that "people only fight for things they love", the unit began with a focus on the affective learning objectives with the aim of increasing relatedness amongst students and the organisms in their local setting.

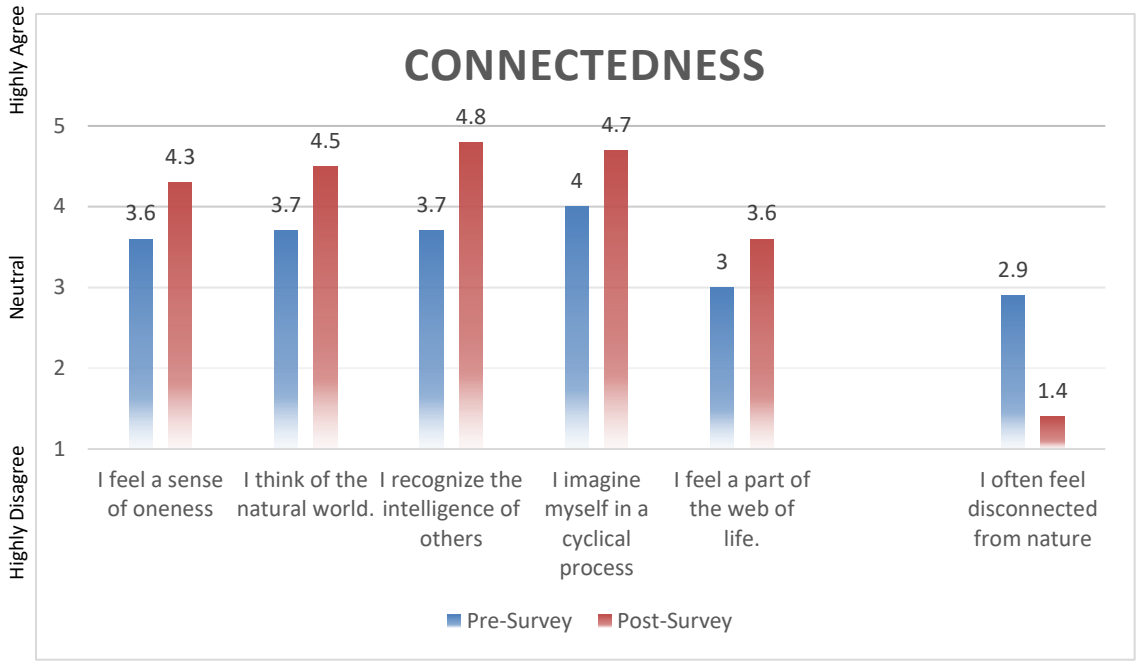

Figure 4.1. Results of connectedness component of student survey.

Classroom activities, like reading Elin Kelsey's (2012) *You are Stardust* and classifying garden organisms, helped create a learning environment that fostered a deeper relationship with other organisms to help encourage pro-environmental behaviors at the school level. Messages in the read alouds, such as "You, me, birds flying through the rainforest. We are all connected. We are all nature. We are all stardust.", naming bird calls, and handling worm specimens all aimed to increase this sense of membership into the larger web of life.

After an analysis of the data collected from the survey instrument, these affective objectives were met. Following the seven lesson ecoliteracy unit, students reported feeling more connected and more appreciative of the organisms that cohabitate their world with them. For example, *I recognize and appreciate the intelligence of other living*

organisms, went from a "neutral/agree" (Avg.=3.7) response to "highly agree" (Avg.=4.8) response by the end of the unit. Lessons where students learned about the important role that worms and microorganisms play in nutrient recycling in the school compost piles allowed students to develop an increased awareness for their value in the outdoor setting. Transcripts from student interviews, such as Annie's comment "You taught me that bugs help the Earth and so now they don't bother me as much", also supported the idea that their experiences in this unit helped foster an increased appreciation for these organisms which, in turn, resulted in an increased appreciation for the outdoor setting.

Student average responses for the statement *I often feel disconnected to nature* went from "neutral" (Avg.=2.9) to "highly disagree" (Avg.=1.4) by the end of the unit. Although this idea of connectedness to nature appeared to be impacted, smaller changes were made when discussing specific opinions regarding webs and cyclical processes of life. Even though Capra (2007) includes networks and cycles as a few of the big ideas of Ecological Literacy, this intervention did not appear to affect their understanding of these systems in the way that it was intended during curriculum development.

Cognitive Domain of Survey (See Appendix E)

Largest overall gains were evident in the cognitive domain of this survey. Students increased their awareness of how composting mimics the natural environment's ability to recycle nutrients back into the soil. Students reported an increase in understanding about the materials that are compostable and the processes that impact the breaking down of nutrients (See Figure 4.4). Although there was still an impact to the students' opinion on the statement *"All living things (miroorganisms, plants, animals,*

and humans) rely on one another," this question saw the smallest reported effect. This might be due to the ceiling effect (Avg.= 4.2) on the pre-survey which left little room for growth. Also, this question correlates to the other smaller impact size on other questions pertaining to webs and nested systems found in nature.

Overall, students seemed to confidently report what material should go into the compost piles and why it is an important process to undertake. When aligned with the principles of Ryan and Deci's (2000) SDT, this increase in self-reported competency levels might explain the motivation to engage in the ecoliterate activities in the school as evident in the changes to behavioral domains (See Figure 4.6) and behaviors documented during field notes.

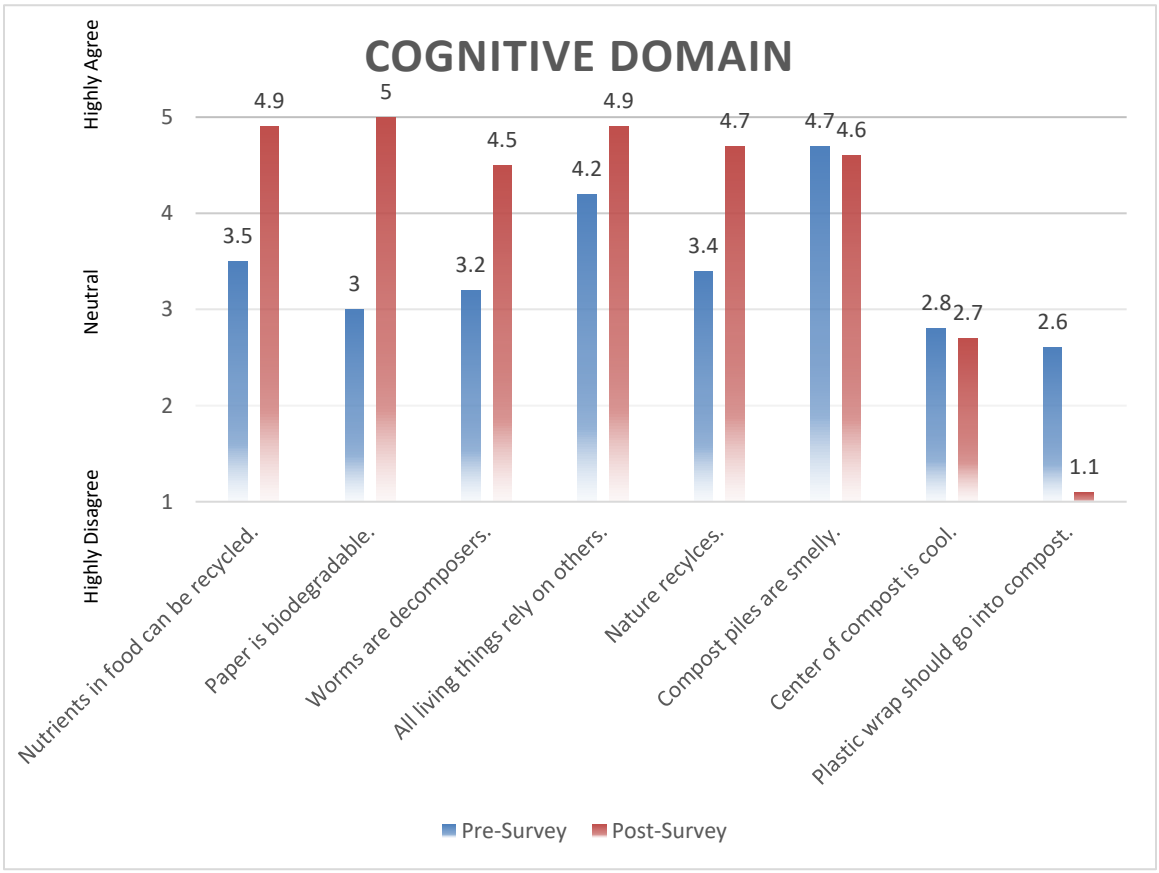

Figure 4.2. Results of cognitive domain of student survey.

Students opinions about compost piles being "*always very smelly*" and "*very cool*" in the center did not change during the unit. Responses for both the pre- and post-surveys indicated that students' responses remained on average "neutral" (Avg.=2.8 to 2.7) to their opinions on the temperature of compost even though data collection on a class anchor chart consistently reported hot temperatures over the 10 weeks of the study. Students also "highly agreed" (Avg.=4.7 to 4.6) that "*compost piles are always very smelly*" on both the pre-survey and post-survey consecutively. Although the teacher-researcher and students repeatedly discussed how to create compost that does not stink, students' opinions were only affected by a .10. Even after visiting the working piles and saying it often "smelled like dirt," students could not change their opinion at the end of the study. This may be because students worked daily in their green compost bins of fruits and vegetables during lunch time and only participated in the outdoor piles every six days. Green compost bins did have a smell if not cleaned every other day because of the lack of "brown" materials, like paper, leaves, and sticks, that make a compost pile less potent over time.

Emotional Domain of Survey (See Appendix E)

Relatedness in SDT is the need to have close relationships with others (Ryan & Deci, 2000). When nurtured in an environment that also fosters competency and autonomy, Ryan and Deci (2000) concluded that motivations in individuals should be evident. Students appeared to be motivated overall by the lessons in this unit because they appear to feel more competent (See Figure 4.3) and connected (See Figures 4.1 & 4.4). Lessons in this unit also aimed at impacting Ryan and Deci's third psychological need, relatedness, not just in terms of building better relationships amongst the students

and teacher-participant, but as it pertains to connecting with all of nature and its organisms.

The data indicated that students had discovered a sense of relatedness that existed beyond the individuals participating in the study. For instance, after the intervention, students now "highly agreed" that they "*recognize and appreciate the intelligence of other living organisms"* (Avg.= 4.8) and "*think of the natural world as a community to which I belong*" (Avg.=4.5). This community relatedness allowed students to find their place as a codependent partner in nature and understand the significance of their actions. A stronger negative response to statements about "*not worth doing things to help,*" behaviors not effecting the environment, and not being "*responsible for pollution*" indicate a more consciences, empowered approach to environmental issues. Positive changes to the statement, "*Human beings are not more important than other creatures,*" further contributes to the findings that students are conscious of their role in a larger community.

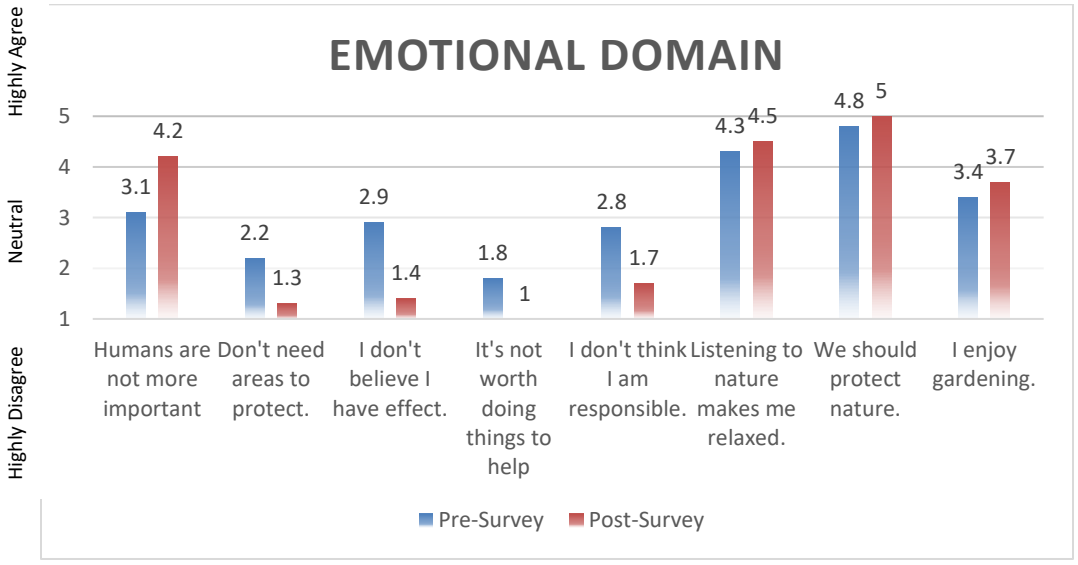

Figure 4.3. Results of emotional domain of student survey.

Three questions out of the eight showed little effect. Students already both "agreed" (Avg.= 4.3) that "*listening to the sounds of nature makes me more relaxed*" (Avg.= 4.3) and "highly agreed (Avg.= 4.8) that "w*e should protect nature*" on the pre-survey. Both reported a .2 increase in attitude, but because such positive responses were already reported, there was little room for growth during their experiences. The other question that did not show a significant effect was the one regarding the garden. Although activities were developed to make connections to the school garden, student participants did not report a significant change in opinion about it. The classification lessons and ongoing composting activities sought to help them connect their actions to the productivity of the land. Students were neutral to the statement "*I enjoy gardening*" on both the pre-survey (Avg.= 3.4) with only a slight improvement (Avg.= 3.7) at the end of the study.

Behavioral Domain of Survey (See Appendix E)

The student participants' perceptions of their behaviors, as indicated on a 3-point Likert scale (1=Never to 3= Always), showed that they have seen a change in their own behaviors. Students recognize that they now consistently sort their lunch waste, either to

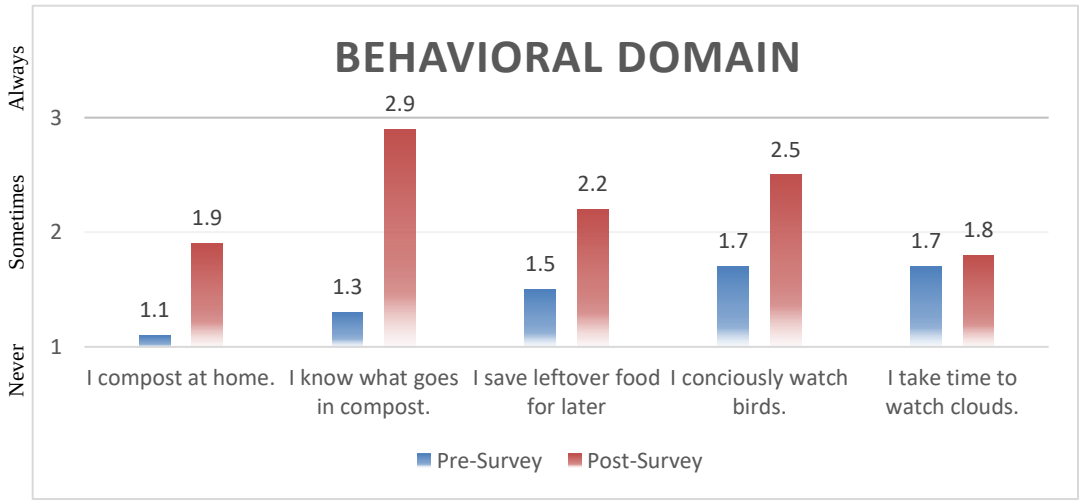

Figure 4.4. Results of behavioral component of student survey.

compost or save the food for later, so they can reduce wasted food in the school cafeteria. Furthermore, behavioral awareness was also evident by the students' self-reported increase of consciousness of birds when outside. Field notes later elaborate on these findings.

Student Nature Journals (Articles & Exit Slips) (See Appendix F)

Journals were used to collect data regarding the three dimensions of environmental awareness (see p. 65 of the literature review). Through open-ended responses, blank pages for drawing, and Likert scales, the teacher-researcher could contextualize the students' perceptions of each lesson. Because ecoliteracy was the goal of this action research study, decisions about the journals tried to display a level of consciousness in sustainability. For instance, cardboard was collected around the school and precut to fit the desired dimensions of the journal. During the first outdoor activity in the unit, students selected a stick that would later help bind their book together with the help of a hole puncher and some rubber bands.

Figure 4.5. Student nature journals.

Throughout the study, students had their journals to document the experiences during the class time, as well as reflect at the end of each lesson. Student-generated written responses and diagrams found in the journals were used to assess the

effectiveness of the lesson on the cognitive and emotional domain of the individuals. Likert scales helped quantify the students' self-perceived connectedness to nature and likability after each activity.

The student participants' journals were coded using inductive coding practices. While cross analyzing them with the lesson objectives, common patterns began to emerge. The results indicated that student enjoyment levels had direct correlations with the setting of the lessons. Specifically, classes utilizing the outdoor classroom always averaged at least two points higher on the 10-point Lickert scale. Each class, students used these pages to document new organisms that were discovered either by drawing them or storing them in the attached plastic baggies.

Just as Ryan and Deci (2000) alluded to with their inclusion of relatedness as an essential psychological need associated with motivation, developing a sense of connectedness was an essential objective throughout development of this study to students. Entries throughout the course of this unit helped provide the evidence to conclude that students increased their sense of community in the natural setting by the end of the study to also include non-human membership. For example, six out the ten students included enjoying the first lesson because they got to work with each other. Ethan wrote after lesson one in the woods, "I loved getting to be outside with my friends." Maggie concurred, "I liked getting to work with my friends when I was outside. It was a lot of fun building a structure out of sticks. I made a nest and my friend made a bird and we put them together."

As lessons progressed, students established a broader view of relatedness in the outdoor setting to include non-human organisms. These responses by the middle of the

intervention demonstrated a heightened awareness level of the organisms found at the local level. Ben wrote, “I really liked getting to touch the worms today!” James explained that he enjoyed the lesson after they “got to hear a morning dove.” Samantha also stated in her journal entry by the middle of her study, “Today was really fun because I got to hear the birds.” Students began drawing pictures with hearts or animals with smiling faces to help depict their affection for Earth and its organisms. Just as these students’ entries demonstrated, an increased enjoyment to the outdoor setting and heightened awareness for their surroundings was also visible throughout the field notes.

Field Notes

The teacher-researcher provided time each day during the 10-week study to create detailed descriptions of the lesson into a journal. Conveniently, a 50-minute plan time directly followed each intervention lessons. Because this time was free from distractions, it became a great time to reflect on the unit and write the field notes. Events were categorically analyzed based on the three domains of environmental awareness: cognitive, emotional, and behavioral. Evidence found from morning discussions and classroom activities from all three domains were described in narrative form to help accurately present the data.

Cognitive Domain of Field Notes.

One of the domains associated with environmental awareness is cognitive development. Through this place-based unit of instruction on waste reduction, students displayed an increase knowledge of the impact that their actions have on the environment and the interdependency amongst its organisms. Students also developed a better cognitive understanding of what composting is and how it benefits other organisms.

Apart from learning the objectives of the lesson, students also appeared to become more engaged in an ongoing knowledge quest as students became notably more inquisitive about the world around them when they were in the outdoor setting.

The overall objective of knowledge growth of composting was met. When the pre-assessment asked the question about if they compost at home, a student asked, "What is composting?" Ethan answered, "It' recycling. Yeah, my family recycles cans and paper and stuff." After the teacher explained that is more than placing recyclables, like paper, glass, and cans, into the green bins. Ethan said, "Oh…never mind. I guess we don't do that." By the end of the intervention, students were able to explain the process of composting and its benefits for plant growth. During lesson five, students also studied the vermicomposting bin and discovered the benefits of including both paper and food scrapes to the worm bin.

Cognitive growth was also obtained through a mini lesson on food value. Halfway through the intervention unit, the teacher-researcher pulled out the 11 whole apples from the compost bins. Although it is difficult to conclude where this ecoilliterate behavior was coming from because at this point second through fifth grade were contributing to the green cafeteria bins, students utilized this opportunity to visualize the impacts of these actions on our planet. With the image of all the apples lined up in a row, the teacher explained that each apple took anywhere from 17 to 19 gallons to grow. Correlating this waste in water to drinking out of the water fountain, students understood eating the apple allowed for that water to help nourish but just throwing it away was like letting the water continuously trickle out of the faucet with no intentions of drinking it. Holding up two gallons of water, the teacher research asked the class how much water

was wasted from the 11 apples found in the compost. Although the teacher stated that she could use a calculator if they wanted, the kids were completely engaged in the task explaining that "No, we can do this" as they all began to complete the math in their nature journals. James volunteers the answer, "That was 209 gallons of water wasted. That's a lot!"

As the lessons also aimed at increasing their connectedness to nature, students actively engaged in lessons of exploration in the outdoor setting. This elevated motivation allowed for cognitive growth associated with the many organisms found in the local setting. Students utilized their nature journals to document their learning. For instance, during sixth lesson in this unit, students learned about the interdependency of the Plant and Animal Kingdoms and how shapes and colors of flowers might signal the pollinators that it seeks to attract. Students also learned about pinnate and palmate leaves and enjoyed completing leave rubbings to document the new knowledge.

Figure 4.6. Evidence of impact to cognitive domain during intervention.

Cognitive growth of the local environment became observably more intrinsically motived as students continuously developed inquisitive reactions to their outdoor setting: "How can you tell if a leaf is poison ivy?", "Can you do a leaf rubbing if it isn't green?", "What is this fuzzy stuff on this stick?", "What are the white things in this soil?", "What kind of caterpillar is this?", and "What is milkweed and why are monarchs endangered?" The ever-changing outdoor learning environment allowed for students to feel empowered as the teacher no longer had full control of what they would discover. The teacher role naturally materialized into more of a facilitator role, or a co-learner, during these lessons. Species of birds and insects presented themselves that were unknown by the teacher-researcher. When she admittedly announced that she did not know the students' organisms they discovered, she increased student engagement levels. Together, the students and the teacher-researcher would research in books and on the internet to classify the unidentified species. While this was first modeled, eventually students began to identify key words to type in to narrow their search engine results on their own.

Emotional Domain of Field Notes

The evidence over the course of the place-based unit of waste reduction indicated that students were able to increase their understanding of what it means to be an ecoliterate person, not only at the cognitive level but emotionally as well. Initial answers to the question, "What does it mean to be ecoliterate?" only included behavioral tasks such as "picking up trash" and "not wasting food." Over the course of unit, students understood the emotional connection that must also exist in ecoliteracy lessons. Annie explained during the beginning of lesson four, that "being an ecoliterate person means taking care of everyone."

This became a great framework over the course of the unit of study as it sought to help engage students through Ryan and Deci's (2000) motivational theory. Just as stated in the SDT, the psychological need of relatedness is the universal desire for feeling connected with others and experience caring for others (Ryan & Deci, 2000). Exit slips during the first two lessons initially indicated that most students' attitudes about being outside were positively affected because they correlated being outside with getting to work together with their friends.

A group of girls from the invervention group asked if they could help with the compost bins. These volunteers in the morning composting proceeds indicated that they also liked getting to be together as they worked on "making the world a better place." The student's motivation levels reflected their self-perceived level of ability to effect change. For example, three weeks into the study, Annie shows up with Kimberly and Cara first thing in the morning to help with maintaining the compost bins. As she turns to go down the hallway, Annie first glances at the other two girls. She exclaims, "Let's go…time to save the world!" as she threw her fist up into the air and proceeded to led them toward the bins. This enthusiasm continued through the study and eventually led to an addition six volunteers looking to help in the morning routines. Through multiple conversations the girls expressed a continuing desire to want to be a part of the composting project by saying such things as "Can we really help out with this again next year? I will remind you!"

This sense of community could be correlated to students recognizing that their collaborative efforts were positively impacting their local problem. This acknowledgement of the empowerment was evident in a conversation amongst the

student volunteers and the teacher-researcher in the morning time toward the end of the study. During this time, Maggie announced:

> I was talking to my sister last night. I told her I was getting sad about the state of our planet. She told me that all I had to do was think about what I was doing at school, and if everyone did just a little bit, we could have a better world!

Annie added:

> Yeah, it's like with our morning group. We started out with the three of us and now Maggie wanted to come too. Now, we have a bunch of people asking when they can help out too. Like, the other day, when we were cleaning the green buckets a second grader came up and asked if they could help out. It feels good because I feel like I am making the world a better place!

The teacher-researcher then concluded the conversation with introducing the girls to a phrase: "Think globally, act locally." Clara probes, "What does that mean?" After the teacher-researcher explains the idea of thinking about the big picture but doing things in our small setting to make an immediate difference, Kimberly, having contemplated it for a moment, then replied, "Yeah, that's what we are doing!" This connectedness amongst each other was observably impacting their motivation levels and empowering them to continue to work toward their common goal of waste reduction at the local level.

The ability to connect with the organisms in the outside world appeared to be positively impacted by the lessons in this study. For instance, Ben showed a heightened interest to nature as the unit progressed. He took considerable attention to documenting his adventures both with drawings and artifact that he added into his journal. After the first lesson, he explained, "I'm so excited! I found my first bird feather on my first day!"

and glued it into it. During the second lesson, he was especially interested in checking birds off his backyard bird list. After hearing that the cardinal was a boy, he questioned how we know that and after learning about the color variations then proceeded to proudly classify some other ones as male and female later in the lesson. During each outdoor exploration, Ben continued to find something that he would bring to the teacher-researcher's attention to get a deeper understanding of his surroundings: feather, a stick with lichen growing on it, a spikey black and orange caterpillar.

Outdoor activities, as reported in both the field notes and student generated 5-point Likert scales at the end of each lesson, produced higher levels of enthusiasm. At the end the second lesson in the forest, Samantha concluded, "Ahh, I wish I could stay here longer." This eagerness continued throughout the unit. Specifically, lessons always began with at least one student asking if they were getting to go outside today. This would be followed by a group cheer when the answer was yes. Even in the morning routines, the girls would always find reasons to go outside. This oneness with nature was best summarized during a conversation with Kimberly on one of the last days of the study. She pleaded, "Can I go out just 2 more seconds? I want to take it in just one more time before I have to go to class!" The teacher-researcher asked her, "What do you love about being outside?" She stands in the center of the sidewalk, arms outreaching, with her head leaning back to embrace the sun, and replied, "The air, the sound of the birds, the sun! I just love the outdoors! It's where I belong!"

Behavioral Domain of Field Notes

Environmental awareness's behavioral domain was also visibly affected as students observed, collected, and analyzed their waste in the cafeteria. After completing

their waste logs, all students explained that they are more consciously aware of their food. By the end of the third lesson, all students concluded that they now saw the value in their food and were deliberately looking to reduce the amount wasted. They became intentionally aware of choices they made in the cafeteria and how to make the least impact on their overall waste. For instance, students began to realize that the fresh fruits were always better choices "because of the plastic on the other one." They were observed more frequently giving someone an apple or saving it for later instead of just throwing it away.

Students also recognized that there were sometimes events that were out of their control but still showed their competency in controlling how much space their trash would take up in a landfill. For instance, during lesson three of the unit, students were required to analyze the trends in the cafeteria. The teacher-researcher looked at the class's overall cafeteria waste data and stated that "Styrofoam trays are still a problem. It is out of your control whether cafeteria staff decides to use a plastic reusable tray or a Styrofoam one that day. Is there anything that we could still do to make an immediate difference?" Ethan raised his hand and replied, "Well, we could stack our trays before throwing them away. We noticed that it takes up a lot less room in the garbage can that way."

Other observations they made during the week of weighing their cafeteria trash were evident in discussions during lesson three. Clearly, students' competency levels increased as students concluded that little changes make a big difference. The lessons that they learned in observing and measuring their grade's trash were ones they eagerly wanted to share with other grade levels. James asked, "Can I make a poster about only

taking one napkin? ‘Cause I noticed at my table that a lot of the students were grabbing a stack of napkins. We told them to only take one because they were throwing so many clean ones away.” Megan stated, “I noticed that I only have one food item that gets thrown away each day.” When asked what the item was, she responded with, “Well, it’s my ham sandwich and I don’t like ham.” The teacher-researcher asked her, “Did you ever tell mom that you don’t like ham? Well, if you never tell her and you throw it away each day, what is mom going to think when she opens up an empty lunch box at the end of a day?” Megan hesitates for a moment, “Well, I guess she would think that I ate it.” The teacher proceeds to explain that she noticed this happening frequently where kids are throwing whole sandwiches away and surely, they have not had those conversations at home either. Megan lights up, “Can I make a poster about that? Say something about keeping it in your lunchbox so you can eat it later or so that you remember to have a talk with your mom about it when you get home?”

During a morning discussion during the second week of the study, Annie stated, “I am so much better at eating my food now.” Kimberly replies, “me too.” Annie continues, “I will even eat my green beans now. Even though I don’t really like them, but I don’t want to waste them.” This was conclusive with observations during a lunch meeting with the student volunteers. Annie looked at the other two girls and asked, “Does anyone want my cheese? I don’t want to waste it.” When no one took it, she proceeded to try to eat it instead of having it throw it away.

Besides impacting the students’ behaviors in reducing food waste, activities during the seven-lesson unit increased the students’ awareness levels of organisms both big and small that are common in their local setting. The students’ emotional relatedness

was, therefore, increased as students were taught the names of these different organisms. Just as learning a new person's name helps personalize the relationship, student participants became more in tune with discovering these creatures all around them after learning what they are called. Thus, their behavioral domain was visibly affected. Individuals became more focused on the windows while indoors. While at the beginning of the unit, the teacher was the one telling them to look because a bird flew into the tree nearby, the students by the second and third lessons were the ones drawing the teacher's attention to them so they could classify them together. Even outside of the STEM activities, students appeared to be more focused on the organisms around them. For instance, the teacher-participant was walking behind the fourth-grade students coming in the building from the end of the year celebrations. While the entire grade of students walked be a flower, Samantha stopped and gazed at the butterfly that had landed moments ago. Although she did not know that she was being watched from afar, she proceeded to carefully observe the insect and then ask out loud, "I wonder what you are called." Clearly, like the other students in this study, her psychological need for relatedness, autonomy, and competency appear to be satisfied through ongoing outdoor exploration. Future behaviors of waste reduction should, therefore, continue to be observed as students continue to grow in confidence of their ability to affect change and cognitive growth of their role in the deeply networked systems in nature.

Student Participants Formal-Structured Interviews

Individual student participants were interviewed during the last week of the intervention. During this 10-minute session, individual students were instructed to authentically answer the questions to help better understand the impacts that the

intervention had on them. These interview questions (See Appendix I) provided an in-depth narrative of the students' perceptions about (a) themselves as an individual (b) themselves as a student, (c) and their level of environmental awareness.

- **Student 1: Clara** listed plastics as the one danger posing a threat to our environment. Although she did not verbalize that wasted food is a problem, she explained that composting to make soil is the one way that our school is practicing environmentally conscious acts. She positively concluded in her interview that the unit helped "me think of the world better. We can help it and not just think of it as a garbage pile." It also improved her opinions about going outside for class. She stated, "I don't like going outside but since we started composting, it makes it feel like a better place for me." Although her post survey indicated that the unit impacted her opinion of "*I enjoy gardening*" from neutral to highly agree, she said that her ideas of gardening are still the same but she now knows that she "really likes to compost, expect for having to smell the green bins sometimes."
- **Student 2: Ben** reported that plastic bottles and bags are a major threat to the environment right now. Although he did not also list wasting food, he later explained how Southeast Elementary helps the environment through the composting and recycling programs. Furthermore, Ben stated that he is more conscious of the value of his food since participation in the intervention. "I should really eat all of it or save it for later." Field notes support Ben's heighted consciousness of the outdoors as he found new organisms and questioned what they were in each class. This is conclusive with Ben self-reported intrinsic value

of being outside. “It was a lot of fun being outside because I looked for cool stuff. I had never seen a grub before and that was pretty cool!” He also enjoyed watching the life cycles of plants and listening for birds. “It was cool that everyone goes to Garden Club and gets to help and see what’s changing in there and what’s not.” He also expressed the value of going outside during other subjects. While he reported Language Arts as his least favorite subject because it is sometimes hard for him, he said he “really liked writing poems outside because it gave me things to write about.” He explained that activities like the ones found in the place-based unit in waste reduction should be in all schools because it “could get kids excited about learning!”

- **Student 3: Annie**’s responses during the interview were conclusive with her pre- and post-survey analysis, indicating an increase in environmental awareness across domain categories. She reported significant changes in her self-perceived connectedness to nature. Her responses often reflected her love of animals and her desires to help the Earth. For instance, she explained that composting and picking up trash are two school practices that are trying to combat threats to the environment. “I used to think that animals knew what to eat and what not to eat but I now know that they don’t. That is why I pick out trash now.” Her opinions about the outdoors were also affected as she grew in her knowledge of the interdependence for all organisms, both large and small. She stated, “I used to hate to go outside. My mom would tell me to go out and play. But it was always too hot or the bugs would eat me up! You taught me that bugs help the Earth and so now they don’t bother me as much. It is kind of fun to see what creature I find

when I go out now." She also reported that she used to think that gardening was "exhausting because you had to do weeding and stuff" but now she actually likes it because she got to see different types of animals out there and "I love animals" and got to try food that was growing. Annie concluded by saying that, "yes, we should have lessons like this in school because we got to help the Earth and help animals. It taught us new ways to help!"

- **Student 4: Kimberly** really enjoyed the outdoor components of this lesson, even citing that as her reason for science being her favorite subject. "I love it because we get to do lots of different things like going outside. It's the only subject that we get to do that." She hesitates for a moment, "Well, I guess we could read and write outside like we did in here." Kimberly concluded that littering and throwing away food instead of saving it are all major threats to our environment. She listed composting in our garden and picking up litter around the campus as useful practices for combating these problems. When asked about including ecoliteracy lessons into school, she responded, "yes because kids that don't like the outdoors can be taught about ecoliteracy and why it's so important." This could be a response from her change in opinions over the course of the unit. She internalized that her increase in connectedness to nature impacted her empowerment for helping Earth by explaining, "If I am being honest here, which you told me to be, I really didn't like to go outside and I didn't like going to the garden. It was always too hot. But now, I want to stay outside all the time. I love all the plants! It's great! I always wanted to help the Earth but now I really want too!"

- **Student 5: James** was one of the students that initially expressed his dislike for going outdoors and his concern with his abilities in science. After the intervention, he concluded that he did enjoy participating in the composting unit because "I don't normally get to see things and when I go outside, I get to explore and look at it all." When asked about the school garden, he expressed an enjoyment with being able to classify the different types of plants that were in the school garden. "I didn't know that there were peppers and cabbage out there until we got to research and found a picture on the internet that matched. I liked getting to set the rock down next to the plant to help other people know what is out there." James further stated the necessity for lesson about ecoliteracy because it helped him feel like he "learned a lot about a lot of different things. It should be taught everywhere because I think some people don't know what they are doing when they just throw away things."
- **Student 6: Daphne** concluded that the intervention had positive effects on her relationship with nature. During the beginning of the interview, she reflected to the first lesson in the study. "Remember when we first started and you made me go outside with the class even though I didn't want to? I really thought at first that I would not like going outside but I really did end up liking it. You make it fun because we got to color and touch things, like the worms." She also self-reported the notion of transferability of ecoliteracy across setting. "I used to not like going outside. It was the temperature really, always too hot or too cold. But you taught me a lot and it made me want to enjoy the sun more. I really liked when you had us touch the worm. I always thought it was going to be really slimy but then it

wasn't so weird. It made me start to want to pick up trash and help other creatures. Like the other day, I helped a cat that was going to get hit by a car. I protected it and it made me feel good!" When asked if other schools should include environmental awareness and ecoliteracy into their curriculum, she stated, "yes because I feel like it teaches us lessons on how to protect our world. I feel like it is important to understand because it's like you are hurting yourself if we don't help because we are part of nature and you don't want to hurt animals, right?"

- **Student 7: Samantha** explained during her interview that she thinks that science comes very easy for her. She concluded that littering and wasting food were two major concerns for our planet. Samantha followed this up by explaining that our school combats these issues by pick up trash and "recycle foods like our veggies and fruits." Furthermore, she explained the importance of including lessons like these in schools. "Ecoliteracy has changed my opinions when it comes to outside. I feel more helpful out there, like I am really making a difference."
- **Student 8: Ethan** was the only student that self-described his personality as "outdoorsy." He implied that his connectedness to nature was strongly tied to the animals that live in it. The major threat to our environment has to do with "animals in the sea and trash. They get caught in it and eat it and could die!" Although he did not report wasting food, he listed composting as the one way that we are trying to help the environment at Southeast Elementary. He concluded that the composting unit resulted in him feeling a sense of empowerment. "The unit helped me feel like I was helping the world." He explained that the activities in

the lessons "helped the garden and all the animals in it become more healthy." Ethan concluded the interview by stating that "he really liked the unit because there was so much to do out there" and confirmed the necessity for lessons on ecoliteracy in other schools. "We need lessons like this because if we don't do anything, it will really hurt our animals and the environment a lot. And we can't do that!"

- **Student 9: Megan** reported positive effects of the intervention on her connectedness in nature. While she was one that overtly expressed distaste for the outdoors, both verbally and nonverbally during the first lesson, she concluded that she now enjoys going outside better than before the unit. Like others in her class, she connected her love of animals with being outside. "I used to hate going outside. Now, I enjoy it because I know that I am helping animals. I like getting to see what creatures we could find and knowing that my food was helping feed them." She also explained that she likes going out to the garden and watching the plants grow. It made her "want to eat more vegetables." She explained that her favorite part about the intervention was seeing how she stopped wasting food and sees this as a major reason why other schools should include lessons like these.
- **Student 10: Maggie** responses reflect how she directly related ecoliteracy in turns of protecting animals and helping the greater humanity. She concluded that the biggest threat to the planet was people hurting animals. She also explained that our school is working toward wasting less and composting. She said, "we try to eat as much food as we can so that we don't waste and help feed people that are hungry." When asked about going outside, she concluded that she loved going

outside because she was able to "communicate with other animals! I liked it outside before, but now, it just makes me feel more comfortable." Maggie explained that more schools should include lessons like these because "it helps kids feel like they can change the world!"

On Task Behavior Chart (See Appendix I)

Outdoor classroom setting requires a level of flexibility from the educator because of its unorthodox learning environment. The learning objectives many vary slightly during each outdoor lesson based on what nature chooses to "reveal" itself during that time. Also, some of the sense of control must be released from the teacher role as students should be provided with more freedom to explore their surroundings in a place-based unit. Detailed comparisons between outdoor recess time and outdoor classroom time were utilized, along with the analogy of playing hide and seek with the organisms in the woods, before each lesson to reduce any undesired behaviors.

The nontraditional setting required the teacher-researcher to continuously reevaluate her ideas of on task behaviors. For example, during the second lesson in which the teacher-researcher asked students to find examples of how nature recycles matter and energy, Ethan had a stick in his hand while we walked through the forest. Initial thoughts from the teacher research were concluding that he was goofing or getting ready to hurt himself or others. After reactively taking it from him, he asked the teacher-researcher when she was done with her sentence if he could have it back claiming, "It's my walking stick." He proceeded to use it only as his stated purpose and remained engaged and on task for the rest of the lesson.

Data collected on and off task behaviors showed no variations based on the setting of the lesson. Every lesson, both indoors and in the outdoor setting, resulted in two to three students requiring a warning for off-task behaviors that were unsuitable to the learning objectives. Therefore, there can be no conclusions about place-based in an outdoor setting and its effects on students' on and off task behaviors.

Summary of Findings

As previously discussed, survey results, artifacts and exit slips in nature journals, teacher researcher field notes, and transcripts from student interviews at the end of the intervention were all analyzed separately. Individual data sets were than classified into their appropriate domain (cognitive, emotional, or behavioral) to help identify trends across measurement tools. The teacher researcher created maps of major codes, categories, and any connections between them and then reorganized with new themes emerged. By the end of the study, it was conclusively determined that all three domains of environmental awareness were impacted by the 10-week place-based unit on waste reduction.

Students overall felt a deeper sense of empowerment for change while recognizing their local problem of wasting food in the cafeteria. Students participating in the socially and emotionally engaged ecoliteracy developed a raised awareness of their role in the delicate web of life and connected their love for animals with their need to help them. They also expressed through the various data sets that an outdoor learning is a meaningful, inspiring, and effective learning environment. Collectively from the data sets, three broad themes emerged that holistically capture the overall interpretation of the results of the study.

Interpretations of Results of the Study

While conducting a thematic coding analysis of all the collected data, the teacher researcher found notable trends that emerged from the various data collection instruments. The teacher-researcher's careful examination of the field notes, students' journals, and conversations in both informal and semi-formal interview settings resulted in three emerging themes (a) connectedness to nature, (b) empowerment for change, (c) and value of ecoliteracy. Each of these patterns helped the teacher-researcher obtain a unique perspective in response to the action research question on whether a place-based unit of study on waste reduction could increase students' environmental awareness levels.

Theme One: Connectedness to Nature

Survey results, interview responses, field notes and student journals all documented the effects that the intervention had on the students' overall feelings of connectedness to nature. After the pre- and post-survey analysis, data results indicated that students felt more connected with the world around them, felt a deeper sense of oneness with the outdoors, and were more appreciative toward the intelligences of other organisms at the end of the study. A sense of community also developed amongst the students and organisms found in their local setting.

Many students expressed their enjoyment with learning about worms and listening to birds. By mastering these lesson objectives, students articulated feeling a heightened awareness amongst other creatures and their significance in our environment. For instance, Annie stated during her interview, "You taught me that bugs help the Earth and so now they don't bother me as much. It is kind of fun to see what creatures I find when I go out now." Ben also demonstrated the joy of discovering new creatures by explaining

that he "had never seen a grub before and that was pretty cool!" Daphne explained that she thought the worm was going to be "really slimy but then it wasn't so weird," which she reported during her interview resulted in her now performing other ecoliterate actions in her community. During the field notes, students continued to demonstrate an increase in consciousness of their surroundings as students explored their environment for new creatures to discover. Presented as a hide and seek game, students discovered that a quiet demeanor and careful attention to detail resulted in uncovering the most hidden creatures.

Students' connectedness to animals encouraged a heightened appreciation of being outside as well. Motivated by their love for animals, many students expressed how they now see their presence outside as opportunity to improve conditions for these beloved creatures. As reported during the interview process, many students before the intervention cited weather and bugs as drastically impacting their desires to go outside. This sort of behavior was evident in the classroom as well. Before exiting the classroom to start the first outdoor lesson, Megan and Daphne approached the teacher-researcher, "We don't really want to go outside." Evidently, both girls came to appreciate the outdoors. Daphne explained, "you taught us a lot and it made me want to enjoy the sun more." Megan made connections to being outside with her love of animals. She explained, "I used to hate going outside. Now, I enjoy it because I know that I am helping animals." Clara also concluded that activities over the course of the unit helped her "think of the world better." Others explained that they now think that the outdoors "is a better place" where they can "communicate with animals."

Motivation levels continued to be visibly high as students explored frequently and presented a vast array of thoughtful questions whenever in the outdoor setting. Students,

motivated by the environment, actively participated in reading and writing activities with more enjoyment when in the outdoor setting. Students explained that they "loved seeing the parts of the book in real life" and wished that their homeroom teacher "would read to us under that tree too." Writing in their nature journals produced higher student reported enjoyment levels because many students felt that writing in nature "was relaxing". Specifically, students reported in their nature journals a "neutral" (Avg= 5.5) rating on their 10-point Likert scale during indoor writing assignments versus their "enjoyed" (8.2) reporting in the outdoor setting. Therefore, data collected during this 10-week qualitative research study supports the interdisciplinary approach to ecoliteracy in an outdoor setting. Not only did it appear to increase environmental awareness levels for sustainability, it showed potential for activating student motivation for engagement across various subject levels.

Theme Two: Empowerment for Change

Students also developed a heightened critical consciousness as they became aware of their role in the stability of our environment. Specifically, student expressed an overall increase in awareness for the value of their food. Ben explained that "I should really eat all of it or save it for later." Megan stated that she now "wants to eat more vegetables." Maggie also explained that she sees kids at school trying to "eat as much food as we can so that we don't waste." As students continued to see how their immediate actions in the cafeteria began to impact their overall quantities of wasted food, students became empowered as their competency and autonomy levels grew. Students confidently reported that they affected change in the cafeteria and created posters to help others follow their more ecoliterate actions. Students created large signs with messages

promoting smaller portion sizes in the salad bar area, grabbing less napkins, and stacking their trays during Styrofoam tray days. They encouraged others to recycle their fruits and vegetables to support a healthier planet by drawing cute animals, gardens full of flowers, and an Earth surrounded by hearts.

As explained by utilizing Ryan and Deci's (2000) notion of relatedness, students were able to use their sense of community to help motivate more sustainable practices for the future. The ecoliteracy lessons were able to utilize this almost inherent connectedness to animals to help motivate students toward more environmentally friendly actions. Annie explained, "I used to think that animals knew what to eat and what not to eat but I now know that they don't. That is why I pick out trash now." Daphne concluded that after building a relationship with the worms, she started becoming more aware of her presence in nature and even tried to protect a cat from danger while Ethan talked about how he started thinking about inventions to help shrimp boats become safer for other animals.

All students concluded that ecoliteracy units are essential to student development because of the importance of helping the planet. For instance, Daphne now recognizes her important role in the maintaining the interdependency of all creatures and the environment. "All schools should include these kinds of lessons. It teaches us how to help. And if you don't take care, it is like you are hurting yourself because we are all part of the environment and you don't want to hurt animals, right?" Students concluded their experiences over the seven lessons increased their willingness to engage in ecoliterate practices, provided them with "new ways to help" and improved their feelings of personal impact. For instance, one morning Annie turned to lead the other two girls down the hall to complete their morning maintenance of the compost bins. She turns to the Clara and

Kimberly and says, “Let’s go save the world!” as she throws her fist into the air and proceeds done the hallway toward the cafeteria with the girls right behind her. Samantha agreed, “I feel more helpful out there, like I am really making a difference.” As students appear to discover their important role in the interdependency of others in their local environment, students reported developing a deeper relationship with it. For example, Cara and Maggie concluded that their experiences over the course of the unit helped make nature “more comfortable” and overall “feel like a better place for me.” Maggie explained that more schools should include lessons like these because “it helps kids feel like they can change the world!”

Theme Three: Value of Ecoliteracy

Relatedness, according to SDT, is an individual’s self-perceived levels of connectedness to others and, if nurtured, can result in increased levels of motivation (Ryan & Deci, 2000). Students in the study, especially during the morning composting units, displayed heightened motivational levels. Appearing each morning to complete the morning maintenance of the compost bins, Annie, Clara, and Kimberly developed a deeper connection with each other. They explained that they really enjoyed volunteering in the morning because they got to “hang out with each other,” the teacher-researcher, and felt good about helping the environment. This connectedness for a common goal extended to others as a core group of six girls eventually helped maintain the bins by the end of the study.

Ecoliteracy, with its focus on development of sustainable societies, requires individuals to consciously think of others and the interdependency that exists. This became a great foundation for lessons both directly linked to the classroom objectives

and ones that materialized because of the student dynamics for this study. The teacher-researcher would refer to Capra's (2007) notions of nested systems, diversity, and the interdependency of all creatures when arguments amongst the students would arise. Students appeared to be much more receptive to listening to conflict resolution solutions when framed around the ecological literacy principles.

Take, for instance, a situation during the morning time were students were presented with a real-world example of what sustainability must look like in order to develop more equity in our societies. Clara, Annie, and Kimberly became quite happy with getting to pick off a few loquats off the tree for snack after their morning duties. When told that fifth graders were going to be taking some off for a lesson, they got quite defensive. This led to a great conversation on the foundation of sustainability in which we should take what we need not just what we want for the greater good of others. Over the next couple weeks, these three girls would often comment about how they missed getting to take as many loquats as they wanted but knew "that it is better to share." This supported the conclusion that experiences during this unit strengthened their emotional domain of environmental awareness, but, more importantly, also helped develop more ecoliterate individuals. These situations that materialized organically helped students develop and strengthen their emotional, social, and ecological intelligences which are "essential perspectives that develop empathy, mindfulness, and new modes of cooperation to help communities live sustainably" (Goleman, Bennett, & Barlow, 2012, p. 6).

At the beginning of each lesson in this unit, the question, "Are you ecoliterate?" was displayed on the board when students walked into the classroom. Not only did it help

students develop an increased consciousness about their actions and their impacts on the environment, it also became the framework for good citizenship in the classroom. Goleman, Bennett, and Barlow (2012) concluded "people who are ecoliterate cultivate compassion toward other forms of life" (p. 12). This became the principles for development over the course of the 10-week unit. The teacher-researcher began using the word as a term of endearment. For example, during the worm lesson, the teacher-researcher started adding worms to the trays so students could take it back to their tables to explore in greater detail. Clara stood back and stated, "I can be the last because I have already seen them." Samantha replied, "I don't mind waiting either. You guys can go ahead of me too." This followed by the teacher-researcher praising them for their ecoliterate behaviors and their ability to affect classroom dynamics in positive ways.

Students embraced the organisms that were studied with respect and dignity, even creating a burial site for a worm that was discovered to be dead one morning. Orr (2005) emphasizes the importance of the development and nurturement of these sorts of empathetic students. He described the serious problems of our society today:

> first and foremost problems of heart and empathy, and only secondarily problems of intellect. In other words, mere smartness is much overrated and is not, as is widely believed, entirely synonymous with intelligence. But good-heartedness is a kind of long-term intelligence. (Orr, 2005, p. 105)

With the ongoing analogy of literacy lessons and how they help develop great readers and writers, students developed their ecoliteracy through the lessons in this unit without judgement. Students were reminded how lessons in literacy help develop skills that can be behaviorally displayed by a literate individual at school. Just as students

cannot be accountable for skills that they were never taught in their Language Arts classes, individuals were reminded throughout the unit that judgements and guilt of ecoilliterate behaviors before the lessons in this unit had no place in the classroom. James explains the importance of increasing consciousness across the country to battle environmental issues by stating, "It should be taught everywhere because I think some people don't know what they are doing when they just throw away things." Students recognized that ecoliteracy lessons helped them develop into individuals that are actively engaged and displaying ecoliterate behaviors. Annie reported that these lessons should be taught everywhere because it introduced them to "new ways to help."

Other student participants reported that ecoliteracy should be an essential component to all schools' curriculum programs because it "could get kids excited about learning" and provided "lessons on how to protect our world." Opportunities to explore the local setting and empower students for environmental change in this place-based unit of waste reduction appeared to provide the perfect opportunity to recognize and support individuals. Thus, it seemed that ecoliteracy units might provide effective frameworks in development of educational environments that promote both intrinsic motivations and character development in future student populations.

Conclusion

The data presented and analyzed in Chapter Four represented findings from a qualitative action research study designed to determine the potential impact that a place-based unit of waste reduction had on 10 fourth grade students' environmental awareness levels. The teacher-researcher collected data from surveys, student semi-formal interviews, field notes and entries in student nature journals. Key themes of

connectedness to nature, empowerment, and value in ecoliteracy units of study emerged through the process of data collection and analysis. It could be suggested through triangulation of data that the unit of instruction instilled a sense of place and of ownership, pride, and responsibility amongst the student participates. Based on the findings analyzed in this chapter, an action plan was developed for Chapter Five. This action plan outlines implications for practice and future research suggestions.

CHAPTER FIVE

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

Chapter Five of this action research study begins with a brief overview of the findings of the study, including a description of the PoP and the research question. A review of the data collection instruments, along with a summary of the findings were then presented. This was followed by questions that emerged during the data analysis portion of this study. Future research suggestions to strengthen the conceptual understanding of ecoliteracy in an elementary school are included, along with an action plan to share with other teachers at the local level. Following these discussions are the concluding remarks about the action research process and specific implications of the study.

Somehk (2006) postulated that the quality of action research depended upon the reflexive sensitivity of the researchers, whose data collection, analysis and interpretations will all be mediated by their sense of self and identity. Therefore, external validity was affected because of the teacher-researcher's positionality and the limitations that existed within the setting of the study. Although themes emerged as a result of the qualitative coding analysis, future research suggestions regarding ecoliteracy and elementary education are presented to help better understand the transferability of the conclusions of this action research.

Research Question

What impact will a place-based environmental education approach have on the environmental awareness level of fourth grade students in a school located in a southeastern state?

Purpose of the Study

The purpose of this study is to examine the impact that a place-based environmental education approach will have on the environmental awareness level of fourth grade students in a school located in a southeastern state.

Summary of the Study and Implications

The purpose of the study was to evaluate the effectiveness that a place-based composting unit of instruction had on students' environmental awareness levels. Student participants comprised of ten fourth-grade students from Southeast Elementary. While observing students at the local setting, alarming trends developed. Ecoilliterate behaviors, such as throwing away untouched food in the cafeteria or tearing up water cups, were frequently displayed by the student population. Students also displayed disinterest, and in some cases signs of distaste, when it came to outdoor activities in the lab.

Upon careful evaluation, teachers at the local setting, limited by instructional time and pressured to teach to a standardized test, were found to neglect the outdoor classroom setting for learning. With only 5% of the elementary state science standards reflecting some portion of EE or sustainability principles, it was also concluded that teachers do not provide opportunities for students to reflect on their role in the nested systems of our global ecosystem. Because it can be determined that ecoliteracy lessons are, therefore, absent from curriculum and instructional decisions at Southeast Elementary, judgements

cannot be made on the students for their ecoilliterate behaviors until lessons are developed to help nurture their emotional, social, and ecological intelligences.

Thus, research was conducted to help establish a curriculum that aimed to cultivate ecoliterate behaviors in students. Like Capra (2007) explains, a multifaceted pedagogy "must foster in learners an understanding of nature's principles, a deep respect for living nature, and long-lasting relationships with the nature world" (p. 18). Sobel's (1999) argued EE must avoid teaching to despair, especially in younger children, because of its tendencies to leave them feeling disempowered and hopeless. Instead, a "love of place" and "a sense of connection or belonging" became foundational toward development of sustainability values at the local level (Singleton, 2015, p. 1).

Over the course of a 10-week period between March and May of 2019, student participants were exposed to seven lessons in the place-based unit in waste reduction. Data was collected through a variety of instruments, including pre- and post-intervention surveys, exit slips, field notes, and formal interviews, to measure the impact that the lessons had on students' environmental awareness levels. Being that environmental awareness exists as a measurable construct through a multidimensional lens, these instruments were designed to quantify the level of environmental knowledge (cognitive component), personal attitudes toward solving environmental problems (emotional component), and levels of participation in environmental activity (behavioral component) (Nazarenko & Kolesnik, 2018).

An inductive coding analysis was utilized in this study to help evaluate the use of ecoliteracy in an elementary school setting. Overall, findings indicated that the place-based unit was effective in impacting environmental awareness levels in ten fourth-grade

students. Through synthesized results from the various instruments, common themes also emerged. Overall, student participants displayed an increase in (a) connectedness to nature, (b) empowerment for change, and (c) value of ecoliteracy. Each of the four separate data sources conclusively supported these themes. Although evidence of students' increased awareness of the ecoliteracy principles of interdependency and empathy for all life appeared within the data, the subcategory of cyclical processes and webs of life appeared to have smaller effect sizes.

An important finding of this study was the transferability of the principles of place-based learning and ecoliteracy across situations. The outdoor classroom proved to be highly motivating for students as they connected to their natural environment through literature and writing assignments. With their increased levels of appreciation for nature, students began describing outside as a "relaxing" and "better place" for them and concluded that they were more motivated to write outside because it gave them "things to write about." Students also verbalized that more time should be spent reading outside because it increased their enjoyment levels. Inquiry skills also appeared to be enhanced as students explored the outdoor setting and became increasingly inquisitive about organisms at their local level. These findings indicate that similar experiences could prove to be beneficial in increasing students' motivations for engagement across subject areas.

Lastly, the results of this study indicate that ecoliteracy could also be a beneficial framework when designing character development programs and empowerment opportunities in an elementary school. Sobel (2008) explained that "place-based education is about connecting people to people, as well as connecting people to nature"

(p.62). As a result of developing a curriculum around these principles, students' level of relatedness increased, not just in terms of building better relationships amongst the students and teacher-participant, but as it pertains to connecting with all of nature and its organisms. Students' heightened awareness of the interdependency that exists in nature appeared to influence their sense of community within the classroom setting as well. Students appeared to be more receptive to discussions of respecting each other, such as limiting resources being used or cutting in line, when framed within the context of being an ecoliterate person.

Also, by collecting data in the cafeteria, students over the course of the study became more conscious of the value of food and were able to recognize how their choices of waste reduction impacted overall trends in the cafeteria. As a result, students in this study expressed a sense of empowerment for change. Although this has immediate effects on their self-perceived levels of competency on impacting future environmental issues, this theme has bigger implications for society. Broom (2015) emphasis that empowered citizens are the foundation of democracy. He further clarified by explaining that "empowered individuals can consider varied perspectives, negotiate with others, amend policies as needed as they can think independently, make their own decisions thoughtfully and with reference to relevant information, and act on that knowledge" (p. 81). Therefore, by providing students with opportunities to feel empowered, schools encourage individuals to actively engage with their worlds, fulfilling their civic right and a responsibility.

In summary, the ecoliteracy unit of study, set within the context of this study, proved to be effective in changing student dispositions and environmental awareness

levels. Positive effects were displayed in cognitive, emotional, and behavioral domains within the student participants. Individuals also appeared to feel more engaged and empowered through experiences presented in the place-based unit of instruction. Therefore, it seems appropriate to continue future studies in order to better understand the practicality when bridging theory with practice in an elementary setting within the context of place pedagogy and ecoliteracy principles. Because intervention proved to have effects on the ten student participants, an action plan for sharing the findings with other teachers was developed. The steps of the action plan were first presented, followed by suggestions for future studies to help strengthen the understanding of ecoliteracy practices in educational settings.

Action Plan

Mertler (2014) emphasized the necessity of the development of an action plan at the end of the research because it essentially puts the "*action* into *action* research" (p. 220). If not properly conducted, it leaves the findings in the abstract, theoretical world instead of bringing it to the practical world of effective teaching practices. Therefore, an action plan was created to help take steps to impact both the teacher-researcher's classroom practices, as well as ignite discussions at the school level on how to use the findings to effect change on a larger scale. With these goals in mind, three specific steps in the action plan emerged. These included (a) integrating ecoliteracy principles across grade levels in the STEM Lab, (b) sharing findings with the other staff at Southeast Elementary School, and (c) conducting additional research based on questions that emerged during the study.

The first step in this action plan was to critically analyze current lessons across grade levels. Only 5% of the state standards address issues of environmental concerns but the intervention proved to be effective in integrating ecoliteracy principles seamlessly across content and situations. Therefore, it is understood that ecoliteracy and place-based learning should not be looked at as curriculum but as theories that effectively guide this teacher-researcher in all classroom decisions. The teacher-researcher developed a classroom learning environment that all students will be a part of during the related arts rotations. Throughout the year, conversations both formally and informally, will be guided by the model of education presented in Goleman, Bennett, and Barlow's (2012) *Ecoliterate* in which cultivation of emotional, social, and ecological intelligences become seamless throughout curriculum and instruction decisions.

Composting practices, which were effectively administered during the intervention period, will be continued for the next school year. Schoolwide cafeteria procedures for waste reduction will be reintroduced to all students at the start of the next school year. Lessons about the science behind the composting pile, as well as lessons to help increase connectedness in the student population, will be added to other grade levels to study both the effect size and transferability of the findings of this study.

The second component of this action plan included educating the staff at Southeast Elementary about ecoliteracy and place pedagogy. Niemiec and Ryan (2009) connected the idea of utilizing the local setting to impact student motivations by explaining that "people are innately curious, interested creatures who possess a natural love of learning and who desire to internalize the knowledge, customs, and values that surround them" (p. 133). Although research exists, teacher at the local level appear to

lack an understanding of the impacts that ecoliteracy and place-based learning could have on student dispositions and motivation levels. For example, a SurveyMonkey was created during this study to evaluate teachers understanding of these two frameworks. Although educators at the local setting overall had heard about constructivist frameworks, such as project-based and problem-based learning, no one reported ever hearing about place-based pedagogy or its implications on curriculum and instruction decisions. Furthermore, teachers reported not knowing what ecoliteracy was or the importance it plays for future sustainable communities.

At the beginning of each school year, the STEM committee is required by school administration to create goals for overall school improvement. Because this teacher-researcher was the department chair, this setting provided an effective environment for introducing teachers to the principles of ecoliteracy and place-based education, along with the findings of the study. Teachers who choose to join this committee typically have an inherent desire to enhance science skills. This smaller setting, with like-minded individuals, appeared to present itself as the best opportunity for informing the staff on interpretations of the data collected during this action research. Therefore, one goal for the STEM committee for the 2019-2020 school year will be to increase staff awareness of ecoliteracy and place-based pedagogy.

Findings of this study support the implementation of ecoliteracy units of study in an elementary school setting because of the positive effects on environmental awareness levels in ten fourth-grade students. Yet, the cyclical nature of action research in education alludes to the necessity to look at the methods and results through a critical eye. Results should be shared so that interventions can be tested across a variety of settings and

participants in future studies. Therefore, discussions on implementation will also be conducted in the STEM committee meetings as educators at Southeast Elementary seek to find practicality of implementing these practices in a standards-driven educational system.

The third component of the action research plan included the teacher-researcher conducting addition research for the PoP over longer periods of time and larger student populations. Because of the nature of the study, limitations existed which weakened the external validity of the study. For instance, fourth grade students were only exposed to seven lessons over a 10-week period because of the nature of the six-day related arts schedule. Although the nature of the qualitative data yielded positive student responses to the intervention, more research should be done to strengthen the overall findings. Reframing the study to include different age groups will contextualize ecoliteracy in a broader population.

Furthermore, completing additional informal observations in future implementations of this study will help strengthen the results. Because qualitative research must be conscious of the biases that exist within the data, the teacher-researcher tried to implement instruments that would help triangulate the findings. Even with these efforts, the Hawthorne Effect, in which participants improve their behaviors and attitudes due to the realization that they are being observed, was a potential weakness within the data. Smith and Noble (2014) postulated that comparisons across participant accounts and prolonged involvement could help reduce bias that naturally occur in this type of work. Therefore, continuing to explore these topics could help strengthen the findings of

this current study, as well as help facilitate a better understanding of how ecoliteracy's effects may evolve across various settings.

Suggestions for Future Research

Inherent limitations exist within the confines of any study. Action research studies are no different. Because the study's purpose is to assist people in developing a better understanding of their situation's unique problems and helps provide a framework for studying tools to confront these issues (Stringer, 2014), external validity always suffers. In order to develop a more in-depth analysis of the findings, therefore, one must participate in systematic reflections of the methodologies and data analysis choices within the unique context of the study. Upon evaluation of the action research choices of this study, some questions emerged. Suggestions for future research are then provided as the teacher-researcher looks to collaboratively reflect with others in "acquisition of new knowledge as it pertains to the teaching and learning process" (Mertler, 2017, p.21).

Through a thematic coding analysis across the four instruments in this study, three overarching themes of (a) connectedness, (b) empowerment, and (c) value of ecoliteracy emerged. While studying these data sources for trends, questions about gender first emerged from within the information sets that supported the themes of value and empowerment. For instance, it was observed by the teacher-researcher that students who became particularly active in ecoliteracy within this composting unit were all girls. Therefore, the first question that emerged was one of gender differences and their impacts on ecoliteracy development. Can gender impact the effectiveness of ecoliteracy and place-based learning in an elementary school? Some researchers, such as Sakellari and Skanavis (2013), have reported that gender does matter. They concluded that women

show “stronger environmental concern and attitudes than men” but that there has been “little recognition of its potential in the context of environmentally responsible behavior” (Skallari & Skanavis, 2013, p.77). Hence, future research would help better clarify the extent that gender impacts environmental awareness as defined through the three domains in this study.

The second set of questions emerged through concept coding during the semi-formal interviews with the student participants. Individuals repeatedly citing animals in their responses for finding value in lessons. Students would explain that exposure to the animals in this unit made them enjoy it more and made them feel more empowered to help the world. Empathy for all creatures also appeared to be strengthened as students understood the necessity to hand the worms delicately. All students seemed attentive during this lesson and even began double checking on the trays and floor to make sure that all worms were accounted for and properly replaced back in the bin at the end of the lesson.

Questions emerged from these reoccurring references to connectedness and care for animals across the data sources. After conducting a student of both rural and urban children, Kellert (1993) concluded that the period from second grade to fifth was most significantly characterized by a major increase in emotional concern and affection for animals, while older students eventually developed a deeper cognitive understanding and eventually ethical concern for them (as cited by Sobel, 2008, p.31). Therefore, Sobel (2008) proposed that educators should provide experiences, especially for nine and ten-year olds, that foster a close allegiance between children and animals. Yet, practically of this proposal appears to blur the lines between research and classroom practices. How

effective would animals in the classroom be on motivational level across subjects? Are effect sizes variant to the age or demographic of the student population? Although motivation levels appeared to increase during this study because of an increased level of relatedness amongst the students and their non-human companions, further researcher would help clarify these questions.

Overall trends appeared to show how ecoliteracy in the fourth-grade student population had positive effects on environmental awareness. The findings, however, raised questions for future studies. For example, within the pre- and post-intervention survey, two questions within the behavioral domain of environmental awareness tried to evaluate students' willingness to "slow down and appreciate nature" but produced different results. While the question "*I consciously watch or listen to birds"* showed positive results after the intervention, *"I take time to watch the clouds pass by"* did not and had to be thrown out because lack of effect size. Although this question about cloud watching was not graphed, it led to other questions when analyzing for thematic patterns found in the intervention. Was this because students were not specifically instructed to watch for clouds during outdoor lessons like they were with the bird population or might it imply that students develop stronger connected to the living things in an environment? Suggestions are then made for more research on students' attentiveness of living vs. nonliving objects in an outdoor setting. Findings could help with future curriculum and instructional decisions in ecoliteracy units of study.

In summary, these questions and suggestions are vital to the continuing development of a conceptual framework for ecoliteracy in an elementary population. It requires the various cycles of plan-act-observe-reflect as the study evolves over time

(Herr & Anderson, 2015). Herr and Anderson (2015) explained the difficulties of looking at action research as a linear product with a finite ending as "successful projects can spiral for years" (p. xiv). Instead, this section reiterated the collaborative and cyclical

Social Justice Component

Justice for our planet and justice for all of humanity are often discussions that are happening simultaneously but often considered unrelated topics (Hansel, 2018). Yet, a critical look at the disproportionate environmental concerns that exist amongst the marginalized populations helps easily connect environmental justice to social justice in the world today. For example, historically speaking, low income and minority communities are exposed to pollution, toxic waste, and other environmental problems at rates much higher than middle-class white Americans (Ahmed, 2018, Fairburn, Walker, & Smith, 2005). Furthermore, a recent United Nations' report concluded that "people who are socially, economically, culturally, politically, institutionally or otherwise marginalized are especially vulnerable to climate change" (IPCC, 2014, p. 6). Therefore, teaching about sustainability practices in the classroom has a component of social justice to it that cannot be ignored. Interpretations of the findings of this study concluded that ecoliteracy and place-based pedagogy might be beneficial frameworks when fighting environmental and social justices in the classroom. Students, for instance, showed increased value in their food and a heightened awareness of the wasted food crisis and its impact on both hungry people and the environment. They also felt a sense of empowerment as they reported wanting to continue to help the world by the end of the intervention.

Indeed, the evidence points to the fact that ultimately, we are in this together and must work collaboratively toward a more prosperous, sustainable, and equitable planet for all (Pastor & Morello-Frosch, 2018). Ecoliteracy and place-based learning environments might provide the framework that is needed in education to help empower students through a solution-based approach to solving global issues. As a result, future research is suggested to see how a heightened sense of awareness to the interconnectedness that exists within all organisms in the nested systems in nature could impact students' dispositions about larger humanitarian concerns.
process that must exist for meaningful research to exist in education.

Conclusion

This action research study sought alternative approaches to learning to broaden the goals of education in America. Historically speaking, philosophers and scholars summarize that the goal of education has always kept human development as the nucleus (Kayode, 2016). This human development in education has consistently fixated only on producing growth within the cognitive domain and quantified it through standardized test scores. Paulo Freire (1968) called this form of education the "banking model": "the teacher issues communiques and makes deposits which the students patiently receive, memorize, and repeat" (p. 72). This form of educational institution neglects the nourishment of emotional, social and ecological intelligences.

Environmental concerns for the 21st century learner require a more holistic approach to education. Yet, teachers at the local level, bogged down by time restraints and pressures of standardized testing, continue to narrowly expose students to concepts only dictated by the state standards. Orr (2005) explained that the goal of education

should not just be about mastery of subject matter but about making connections between head, hand, heart, and cultivation of the capacity to discern systems. Socially and emotionally engaged ecoliteracy was, therefore, developed as a pedagogy for cultivating "the knowledge, empathy, and action required for practicing sustainable living" (Goldman, Bennett, & Barlow, 2012, p. 2). By encouraging active learning and shared decision making, curriculum decisions made with ecoliteracy in mind attempt to move beyond despair and provide constructive, optimistic action in the face of today's significant environmental challenges (Goleman, Bennett, & Barlow, 2012; Burgess, 2010).

Knowledge is believed to be not just stored and talked about, but something to be lived (Margolin, 2005; Reich, 2007). As demonstrated in this action research study, participation in activities over the seven lessons helped increase students' cognitive processing. Student in the study showed an increase in understanding about the science behind composting and the necessity for this practice in nutrient recycling for future crops. Experiences through outdoor learning and composting practices also enhanced student motivations to participate in ecoliterate behaviors at school as they began to feel a greater connectedness to nature. Increased engagement levels also appeared to be enhanced during the Language Arts activities in this unit when administered in an outdoor classroom setting. These positive effects should be further studied as educators look to find ways to encourage active participation in their student populations across subject areas.

The overall lesson development during this unit looked to expose students to the holistic view of interconnectedness in nature that demands our responsibility and

protection (Armstrong, 2005). In other words, instead of teaching to despair, the alternative approach to EE in this action research was one that fostered shared experiences in which students worked to "discover value in the natural world", experiential activities that "encourage the exploration of what we believe and who we are", and provided reflection on how we intend to live in the world (Burgess, 2010, p. 2). As a result, competency levels in student participants increased as students quantified their waste reduction in the cafeteria, assisted in monitoring and maintaining the compost piles, and participated in outdoor classroom activities. As a result, students over the four instrument types reported an increased sense of pride and responsibility to protect their environment.

Curriculum and instructional decisions for this action research study were guided by ecoliteracy principles and place-based pedagogy and inspired by Jane Goodall quote:

> People say think globally, act locally. Well, if you think globally, it is overwhelming, and you do not have enough energy left to act locally. Just act locally and see what a difference you can make! (as cited by Stokes, 2018, para.1)

Therefore, local settings and their problems became a key component of this study. The teacher-researcher found that lessons for sustainability could be integrated across content seamlessly. Students found value in the lessons and all reported the necessity for units like these in all schools.

In conclusion, interpretations of the findings of this place-based unit indicate the necessity for further research into the application of ecoliteracy in classroom settings. Studies like these are vital to the overall educational system because they critically analyze the issues of modern classrooms and utilize the knowledge of the insider to

actively engage in developing solutions. Action research studies like this one improve schools and empower educators resulting in "better instruction, better learning, and more productive students coming out of the classrooms" (Mertler, 2017, p.21). Because ecoliteracy requires a broader view of the individual, one that also includes an awareness of the emotional, social, and ecological intelligences, it requires educators to also change their definition of "productive" individuals.

When free public school became a citizen's right over 150 years ago, it was considered a "factory-model" classroom. Inspired in part by the approach Horace Mann saw in Prussia in 1843, its objectives seemed to adequately prepare American youth for productivity in a 20th century industrialized economy (Rose, 2012). Global concerns for the environment and continuing racial and religious intolerance require a broader stance on what it means to be a "productive" member of society. Social, emotional, and ecological intelligence are essential but often neglected in curriculum development. When Anderson (2005) asked us to "imagine a world in which the good of each human being and each species is considered in every decision made" (p.17), she, like the results of this study, validated the integration of ecoliteracy in our school systems today for a better tomorrow.

Results from this action research study indicate that ecoliteracy principles and place-based pedagogy could be beneficial when trying to include curriculum and instructional decisions that embrace a more holistic approach to education. Classrooms that consciously look for opportunities to expose students to "deep soulful nourishment" that is based on local, biological, interpersonal, and ecological relationships (Ableman, 2005, p. 175) understand that children are more than just their cognitive domains. It is

imperative for both our society and global health that educational systems for the future represent this understanding.

REFERENCES

Abdi, A. (2014). The effect of inquiry-based learning method on students' academic achievement in science course. *Universal Journal of Educational Research, 2*(1), 37-41.

Ableman, M. (2005). Raising whole children is like raising good food: Beyond factory farming and factory schooling. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world,* (pp. 175-183). San Francisco, CA: Sierra Club Books.

Ahmed, A. (2018, Feb. 26). We can't truly protect the environment unless we tackle social justice issues, too. *Popular Science*. Retrieved from https://www.popsci.com/environmentalism-inclusive-justice/

Al-Balushi, S., & Al-Aamri, S. (2014). The effect of environmental science projects on students' environmental knowledge and science attitudes. *International Research in Geographical & Environmental Education, 23*(3), 213-227.

Alp, E., Ertepinar, H., Tekkaya, C., & Yilmaz, A. (2008). A survey on Turkish elementary school students' environmental friendly behaviors and associated variables. *Environmental Education Research, 14*(2), 129-143.

Anderson, K. (2018). Evaluation of school tasks in the light of sustainability education: Textbook research in science education in Luxembourgish primary schools. *Environmental Education Research, 24*(9), 1301-1319.

Andrews, R. N. L. (2006). *Managing the environment, managing ourselves: A history of American Environmental Policy,* (2nd ed.). New Haven, CT: Yale University Press.

Armstrong, J. (2005). En'owkin: Decision-making as if sustainability mattered. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world,* (pp. 30-40). San Francisco, CA: Sierra Club Books.

Artvinli, E., & Demir, Z. M. (2018). A study of developing an environmental attitude scale for primary school students. *Journal of Education in Science, Environment and Health (JESEH), 4*(1), 32-45

Ashbrook, P. (2016). The early years: Composting with children. *Science and Children, 53*(7), 22-23.

Askea, H. (2019). Finding the math in the mountains: Place-based learning in the mountains of southwest Virginia [Special Issue]. *Journal of Sustainability Education, 2-3*.

Awareness [Def. 2]. (n.d.). *Merriam-Webster Online.* In Merriam-Webster. Retrieved from https://www.merriam-webster.com/dictionary/awareness

Ayaydin, Y., Un, D., Acar-Sesen, B., Usta Gezer, S., & Camci Erdogan, S. (2018). Environmental awareness and sensitivity of the gifted students: "Science and Art Explorers in the Nature". *Bartin University Journal of Faculty of Education, 7*(2), 507-536.

Barlow, Z., Marcellino, S., & Stone, M. (2005). Leadership and the learning

community. In M. Stone & Z. Barlow (2005), *Ecological literacy: Education our children for a sustainable world,* (pp. 149-160). San Francisco, CA: Sierra Club Books.

Barrable, A., & Arvanitis, A. (2019). Flourishing in the forest: Looking at Forest School through a self-determination theory lens. *Journal of Outdoor and Environmental Education, 22*, 39-55.

Bennett, L. (2012). What does it mean to be ecoliterate? *Center for Ecoliteracy*. Retrieved from https://www.ecoliteracy.org/article/what-does-it-mean-be-ecoliterate.

Bergman, B. (2016). Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intent to act. *Environmental Education Research, 22*(4), 480-503.

Berry, W. (2005). Solving for pattern. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world,* (pp. 30-40). San Francisco, CA: Sierra Club Books.

Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school gardening. *The Journal of Environmental Education, 40*(2), 15-38.

Boehnert, J. (2012). *The visual communication of ecological literacy: Designing, learning and emergent ecological perception (*Doctoral thesis). Retrieved from ProQuest Dissertations Publishing, (10040486).

Boeve-de Pauw, J., Gericke, N., Olsson, D., & Berglund, T. (2015). The effectiveness of education for sustainable development. *Sustainability, 7*(11), 15693-15717.

Boeve-de Pauw, J., & Van Petegem, P. (2017). Because my friends insist or because it

makes sense? Adolescents' motivation toward the environment. *Sustainability, 9*(750), 1-13.

Boeve-de Pauw, J., & Van Petegem, P. (2018). Eco-school evaluation beyond labels: The impact of environmental policy, didactics and nature at school on student outcomes. *Environmental Education Research, 24*(9), 1250-1267.

Bogner, F. (2018). Environmental values (2-MEV) and appreciation of nature. *Sustainability, 10*(350), 1-10.

Bolling, M., Otte, C., Esborg, P., Nielsen, G., & Bentson, P. (2018). The association between education outside the classroom and students' school motivation: Results from a one-school-year quasi-experiment. *International Journal of Educational Research, 89*, 22-35.

Bott, R. C., & Cortus, E. L. (2014). Students develop compost management skills through experiential learning. *NACTA Journal, 58*(1-4), 313-318.

Bourke, B. (2014). Positionality: Reflecting on the research process. *The Qualitative Report, 19*(18), 1-9.

Broom, C. (2015). Empowering students: Pedagogy that benefits educators and learners. *Citizenship, Social, and Economics Education, 14*(2), 79-86.

Burgess, D. (2010). The heart of sustainability: Big ideas from the field of environmental education and their relationship to sustainability education or what's love got to do with it? *Journal of Sustainability Education*. Retrieved from http://www.susted.com/wordpress/content/the-heart-of-sustainability-big-ideas-from-the-field-of-environmental-education-and-their-relationship-to-sustainability-education-or-what%E2%80%99s-love-got-to-do-with-it_2010_10/

Buzby, J., Wells, H. F., & Hyman, J. (2014). The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States. *US Department of Agriculture: Economic Research Service. Economic Information Bulletin Number, 121*, 1-39. Retrieved from https://www.ers.usda.gov/publications/pub-details/?pubid=43836

Campbell, D. F.. & Machado, A. A. (2013). *Ensuring quality in qualitative inquiry: Using key concepts as guidelines. Moriz, Rio Claro, 19*(3), 572-579. Retrieved from http://www.scielo.br/pdf/motriz/v19n3/07.pdf

Capra, F. (2005). Speaking nature's language. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world,* (pp. 18-29). San Francisco, CA: Sierra Club Books.

Capra, F. (2007). Sustainable living, ecological, literacy, and the breath of life. *Canadian Journal of Environmental Education, 12*, 9-19.

Capra, F., & Luigi Luigi, P. (2014). *The systems view of life: A unifying vision*. New York, NY: Cambridge University Press.

Capra, F. (2015). The systems view of life. A unifying conception of mind, matter, and life. *Cosmos and History: The Journal of Natural and Social Philosophy, 11*(2), 242-249.

Caradonna, J. (2014). *Sustainability: A history*. New York, NY: Oxford University Press.

Carter, R., & Simmons, B. (2010). The history and philosophy of environmental education. In A. Bodzin, B. Shiner Klein, & S. Weaver (Eds.), *The Inclusion of*

Environmental Education in Science Teacher Education (pp. 3-16). New York, NY: Springer.

Chawla, L. (2007). Childhood experiences associated with care for the natural world: A theoretical framework for empirical results. *Children, Youth and Environments, 17*(4), 144-170.

Chawla, L. (2014). Nature-based learning for student achievement and ecological citizenship. *Curriculum and Teaching Dialogue, 20*(1-2), xxv-xxxix.

Christ, C. (2015). Jane Goodall: How to Travel Better. *National Geographic*. Retrieved from https://www.nationalgeographic.com/travel/intelligent-travel/2015/05/26/jane-goodall-what-i-know/

Christensen, P. (1997). Different lifestyles and their impact on the environment. *Sustainable Development, 5*(1), 30-35.

Christodoulou, A., & Korfiatis, K. (2018). Children's interest in school garden projects, environmental motivation and intention to act: A case study from a primary school of Cyprus. *Applied Environmental Education & Communication, 18*(1), 2-12.

Churcher, K., Downs, E., & Tewksbury, D. (2014). "Friending" Vygotsky: A social constructivist pedagogy of knowledge building through classroom social media use. *The Journal of Effective Teaching, 14*(1), 33-50.

Cincera, J., & Krajhanzl, J. (2013, December). Eco-schools: What factors influence pupils' action competence for pro-environmental behavior? J*ournal of Cleaner Production, 61,*117-121.

Cirillo, J. (2016). Educating for sustainability. Case studies from the Field, PreK-12.

Shelburne Farms Sustainable School Project.

Coertjens, L., Boeve-De Paw, J., Maeyer, S., & Petegem, P. (2010). Do schools make a difference in their students' environmental attitudes and awareness? Evidence from PISA 2006. *International Journal of Science and Mathematics Education, 8*(3), 497-522.

Connecticut Department of Environmental Protection (2002). *School composting. A manual for Connecticut Schools: The next step in recycling.* Retrieved from https://www.ct.gov/deep/lib/deep/compost/compost_pdf/schmanual.pdf

Crutzen, P. (2006). The "Anthropocene". In E. Ehlers & T. Krafft (Eds.), *Earth System Science in the Anthropocene* (pp. 13-18), New York, NY: Springer.

Dana, N. F., & Yendol-Hoppey, D. (2014). *The reflective educator's guide to classroom research: Learning to teach and teaching to learn through practitioner inquiry* (3rd ed.). Thousand Oaks, CA: Corwin: A SAGE Company.

Darling-Hammond, L. (2009). New standards and old inequalities: School reform and the education of African American students. In J. King (Ed.), *Black education. A transformative research and action agenda for the new century* (pp. 197-223). New York, NY: Routledge.

Dalton, P., & Sala, E. (2001). Natural history: The sense of wonder, creativity and progress in ecology. In J. Gili, J. Pretus, & T. Packard (Eds.). *A marine science odyssey into the 21st century*, *65*(2), 199-206.

[DartintonTV]. (2011). *David Orr @ Schumacher College: Ecoliteracy and Ecological Education* [Video File]. Retrieved from https://www.youtube.com/watch?v=jxge4AhxlcY

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York, NY: Plenum.

Deci, E. L., Vallerand, R., Pelletier, L., & Ryan, R. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*(3 & 4), 325-346.

Deringer, A. (2017). Mindful place-based education: Mapping the literature. *Journal of Experiential Education, 40*(4), 333-348.

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking in the educative process.* Chicago, IL: Henry Regnery.

DiEnno, C. M., & Hilton, S. (2005). High school students' knowledge, attitudes, and levels of enjoyment of an environmental education unit on nonnative plants. *Journal of Environmental Education,37*(1), *13-25.*

Dietary Guidelines Advisory Committee (2015). *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture.* Washington, DC. Retrieved from www.health.gov/dietaryguidelines/2015- scientific-report/.

Dimopoulos, D., Paraskevopoulos, S., & Pantis, J. (2008, Spring). The cognitive and attitudinal effect of a conservation educational module on elementary school students. *Journal of Environmental Education, 39*(3), 47-61.

Disinger, J. F. (1985). What research says: Environmental education's definitional problem. *School Science and Mathematics, 85*(1), 59–68.

Durdella, N. (2018). *Qualitative dissertation methodology: A guide for research design and methods.* Thousand Oaks, CA: SAGE Publications.

Dyg, P. M., & Wistoft, K. (2018). Wellbeing in school gardens: The case of the Gardens for Bellies food and environmental education program. *Environmental Education Research, 24*(8), 1177-1191.

Elfin, J., & Sheaffer, A. (2006). Service-based learning in watershed-based initiatives: Keys to education for sustainability in geography? *Journal of Geography, 105*(1), 33–44.

EPA (n.d.). What is environmental education? Retrieved from https://www.epa.gov/education/what-environmental-education

EPA (n.d.). Landill Methane Outreach Program (LMOP): Basic information about landfill gas. *United States Environmental Protection Agency.* Retrieved from https://www.epa.gov/lmop/basic-information-about-landfill-gas.

EPA (2018). Composting at home. *United States Environmental Protection Agency*. Retrieved from https://www.epa.gov/recycle/composting-home.

EPA (2018). Sustainable management of food basics. *United States Environmental Protection Agency*. Retrieved from https://www.epa.gov/sustainable-management-food/sustainable-management-food-basics.

Ernst, J. (2009). Influences on US middle school teachers' use of environment-based education. *Environmental Education Research, 15*(1), 71-92.

Fairburn, J., Walker, G., & Smith, G. (2005). *Investigating environmental justice in Scotland: links between measures of environmental quality and social deprivation. Project Report.* Staffordshire University.

Farmer, J., Knapp, D., & Benton, G. (2007). An elementary school

environmental education field trip: Long-term effects on ecological and environmental knowledge and attitude development. *The Journal of Environmental Education, 38*(3), 33-42.

Fisman, L. (2005). The effects of local learning on environmental awareness in children: An empirical investigation. *Journal of Environmental Education, 36*(3), 39-50.

Fleurbaey, M., Kartha, S., Bolwig, S., Chee, Y. L., Chen, Y., Corbera, E., … Sagar, A. (2014). Sustainable development and equity. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A., … & J. C. Minx (Eds.). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 283-350). New York, NY: Cambridge University Press.

Fraenkel, J., Wallen, N., & Hyun, H. (2012). *How to design and evaluate research in education.* New York, NY: McGraw Hill.

Fraj, E., & Martinez, E. (2007). Ecological consumer behaviour: An empirical analysis. *International Journal of Consumer Studies, 31*, 26–33.

Fraser, J., Gupta, R., & Krasny, M. (2015). Practitioners' perspectives on the purpose of environmental education. *Environmental Education Research, 21*(5), 777-800.

Freire, P. (1968/2018). *Pedagogy of the oppressed* (4th ed). New York, NY: Bloomsbury Publishing, Inc.

Frischmann, C. (2018). The climate impact of the food in the back of your fridge. *The Washington Post.* Retrieved from https://www.washingtonpost.com/news/theworldpost/wp/2018/07/31/food-waste/?noredirect=on&utm_term=.0a8e30a3eb9e.

Gadotti, M. (2010). Reorienting education practices toward sustainability. *Journal of Education for Sustainable Development, 4*(2), 203-211.

Gayford, C. (2009). *Learning for sustainability: From the pupils' perspective: A report of a three-year longitudinal study of 15 schools from June 2005 to June 2008*. Surrey, UK: WWF-UK. Retrieved from http://www.londonsustainableschools.org/uploads/1/5/7/4/15747734/wwf_report_final_web.pdf

Gene, M. (2015). The project-based learning approach in environmental education. *International Research in Geographical & Environmental Education, 24*(2),105-117.

Giron, G., Vasquez-Martinez, C., Lopez, J. S., & Banuelos, A. A. (2012, June 12-15). *Environmental education: From the perspective of scientific knowledge for constructivist learning.* Bulgarina Comparative Education Society. Paper presented at the Annual Meeting of the Bulgarian Comparative Education Society. Kyustendil, Bulgaria.

Goleman, D., Bennett, L., & Barlow, Z. (2012). *Ecoliterate: How educators are cultivating emotional, social, and ecological intelligence.* San Francisco, CA: Jossey-Bass.

Goleman, D., Bennett, L., & Barlow, Z. (2013). Five ways to develop "ecoliteracy". *Greater Good Magazine*. Retrieved from https://greatergood.berkeley.edu/article/item/five_ways_to_develop_ecoliteracy

Goodlad, K., & Leonard, A. (2018). Place-based learning across the disciplines: A living laboratory approach to pedagogy. *Insight: A Journal of Scholarly Teaching, 13*, 150-

164.

Goodwin, T. (2016). Educating for ecological literacy. *American Biology Teacher (University of California Press), 78*(4), 287-290.

Grant, C., & Osanloo, A. (2014). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house". *Administrative Issues Journal, 4*(2), 4.

Gritter, K., Scheurerman, R., Strong, C., Schuster, C. J., & Williams, T. (2016). Valuing Native American tribal elders and stories for sustainability study. *Middle School Journal, 47*(2), 3-12.

Ham, M., Horvat, M., & Mrćela, D. (2016). Insights for measuring environmental awareness. *Econviews*, XXIX, 159-176.

Harvest Public Media (2014). *Tossed out: Food in the landfill* [Video File]. Retrieved from https://www.youtube.com/watch?v=8LPWxZ2Q3dk

Henderson, J., & Zarger, R. (2017). Toward political ecologies of environmental education. *The Journal of Environmental Education, 48*(4), 285-289.

Herr, K., & Anderson, G. (2015). *The action research dissertation: A guide for students and faculty*. Thousand Oaks, CA: SAGE Publications.

Holt, M. (2005). The slow school: An idea whose time has come? In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world,* (pp. 56-63). San Francisco, CA: Sierra Club Books.

Hursh, D., Henderson, J., & Greenwood, D. (2015). Environmental education in a neoliberal climate. *Environmental Education Research, 21*(3), 299-318.

Iozzi, L. (1989). What research says to the educator: Part one: Environmental

education and the affective domain. *The Journal of Environmental Education, 20*(3), 3-9.

Jackson, P. (2012). *What is education?* Chicago, IL: The University of Chicago Press.

James, J., & Williams, T. (2017). School-based experiential outdoor education: A neglected necessity. *Journal of Experiential Education, 40*(1), 58-71.

James, L. (2016). Facilitating lasting changes at an elementary school. *International Electronic Journal of Elementary Education, 8*(3), 443-454.

Kaiser, F. G., & Shimoda, T. A. (1999). Responsibility as a predictor of ecological behavior. *Journal of Environmental Psychology, 19,* 243–253.

Kates, R. W., Clark, W. C.. Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., …… (2001). Sustainability Science. *Science, 292,* 641–642.

Kayode, B. K. (2016). The should be goal of education: What should be taught? And how should it be taught? *Journal of Education and Practice, 7*(21), 138-143.

Knight, S. (2011). Forest school as a way of learning in the outdoors in the UK. *International Journal of Cross-Disciplinary Subjects in Education (IJCDSE), 1*(1), 590-595.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239-260.

Kummu, M., de Moel, H., Porkka, M., Siebert, S., Varis, O., & Ward, P. (2012). Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertilizer use. *Science of the Total Environment, 438,* 477–489.

LaMorte, W. (2016). Sampling. Boston University School of Public Health. Retrieved from http://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/BS704_Probability/BS704_Probability2.html

Lincoln, Y. (1999). Emerging criteria for quality in qualitative and interpretive research. *Qualitative Inquiry, 1*(3), 275-289.

Lippuner, C., Pearce, B., & Bratrich, C. (2015). The ETH Sustainability Summer School Programme: An incubator to support change agents for sustainability. *Current Opinion in Environmental Sustainability*, *16*, 37-43.

Lloyd, A., Truong, S., & Gray, T. (2018). Place-based outdoor learning: More than a drag and drop approach. *Journal of Outdoor & Environmental Education, 21*(1), 45-60.

Locke, S., Russo, R., & Montoya, C. (2013). Environmental education and eco-literacy as tool of education for sustainable development. *Journal of Sustainability Education, 4.* Retrieved from http://www.susted.com/wordpress/content/environmental-education-and-eco-literacy-as-tools-of-education-for-sustainable-development_2013_02/

Lodhi, I., Shakir, M., Hussain, Z., & Abid, R. (2017). Effect of outdoor education on the concept attainment of science at elementary level. *NUML Journal of Critical Inquiry, 15*(2), 120-134.

Lord, T. (1999). A comparison between traditional and constructivist teaching in environmental science. *Journal of Environmental Education, 30*(3), 22-27.

Lowenstein, E., & Smith, G. (2017). Making a world of difference by looking

locally: How place- and community-based education can broaden the classroom and your students' viewpoints. *Educational Leadership, 75*(2), 50-56.

Mannion, G., Fenwick, A., & Lynch, J. (2013). Place-responsive pedagogy: Learning from teachers' experiences of excursions in nature. *Environmental Education Research, 19*(6), 792-809.

Margolin, M. (2005). Indian pedagogy: A look at traditional California Indian Teaching Techniques. In M. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world,* (pp. 67-79). San Francisco, CA: Sierra Club Books.

Martin, J., Maris, V., & Simberloff, D. (2016). The need to respect nature and its limits challenges society and conservation science. *Proceedings of the National Academy of Science of the United States of America, 113*(22), 6105-6112.

Mayer, F.S. & Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, 24, 503-515.

McBride, B. B., Brewer, C. A., Berkowitz, A. R., & Borrie, W. T. (2013). Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here? *Ecosphere, 4*(5), 1-20.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation* (3rd ed). San Francisco, CA: Jossey-Bass.

Michael, P. (2005). Helping children fall in love with the Earth: Environmental education and the arts. In M. Stone & Z. Barlow (2005), *Ecological literacy:*

Education our children for a sustainable world, (pp. 111-126). San Francisco, CA: Sierra Club Books.

Mills, G. (2018). *Action research: A guide for the teacher-researcher* (6th ed.). New York, NY: Pearson.

Mills, M., Huberman, M., & Saldana, J. (2014). *Qualitative data analysis. A methods sourcebook* (3rd ed.). Thousand Oaks, CA: SAGE Publications.

Minshew, L., Barber-Lester, K., Derry, S., & Anderson, J. (2017). Leveraging students' knowledge to adapt science curricula to local context. *Educational Technology & Society, 20*(4), 205-218.

Monaghan, K., & Curthoys, L. (2008). Addressing barriers to ecological literacy. *The Ontario Journal of Outdoor Education, 20*(3), 12-16.

Mooney, C., & Dennis, B. (2016, June 6). Scientists say that 'nature', untouched by humans, is now almost entirely gone. *The Washington Post*. Retrieved from https://www.washingtonpost.com/news/energy-environment/wp/2016/06/06/theres-basically-no-landscape-on-earth-that-hasnt-been-altered-by-humans-scientists-say/?noredirect=on&utm_term=.137b906e328e

Nadelson, L., & Jordan, R. (2012). Student attitudes toward and recall of outside day: An environmental science field trip. *Journal of Educational Research, 105*(3), 220-231.

Navarro, O., Olivos, P., & Geury-Bahi, G. (2017). "Connectedness to Nature Scale": Validity and reliability in the French context. *Frontiers in Psychology, 8*(2180). doi: 10.3389/fpsyg.2017.02180

Nazarenko, A., & Kolesnik, A. (2018). Raising environmental awareness of future teachers. *International Journal of Instruction, 11*(3), 63-76.

Nazir, J., & Pedretti, E. (2016). Educators' perceptions of bringing students to environmental consciousness through engaging outdoor experiences. *Environmental Education Research, 22*(2), 288-304.

Niemiec, C., & Ryan, R. (2001). Applying self-determination theory to educational practice. *Theory and Research in Education, 7(2),*133-144.

Nijhuis, M. (2011). Green failure: What's wrong with environmental education? *Yale Environment 360*. Retrieved from https://e360.yale.edu/features/green_failure_whats_wrong_with_environmental_education.

North American Association for Environmental Education (n.d.). Guidelines for excellence: Best practice in EE. Retrieved from https://naaee.org/our-work/programs/guidelines-excellence.

NRDC (2017). Wasted: How America is losing up to 40 percent of its food from farm to fork to landfill. *Natural Resources Defense Council.* Retrieved from https://www.nrdc.org/sites/default/files/wasted-2017-report.pdf

Orr, D. W. (1994). *Earth in mind: On education, environment and the human prospect*. Washington, DC: Island Press. Retrieved from http://my.woodbury.edu/Faculty/Writing/AW%20112%20Sustainability%20Reading%20List/The%20Sustainability%20Reading%20List%20(Selected%20Documents)/Orr,_D._Earth_in_Mind.pdf.

Orr, W. (2004). *Earth in mind: On education, environment and the human prospect*.

Tenth Anniversary Edition. Washington, DC: Island Press.

Orr, D. (2005). Foreword. In M. Stone & Z. Barlow, *Ecological literacy: Educating our children for a sustainable world,* (pp. ix-xi*).* San Francisco, CA: Sierra Club Books.

Orr, D. (2005). Recollection. In M. Stone & Z. Barlow, *Ecological literacy: Educating our children for a sustainable world,* (pp. 96-106*).* San Francisco, CA: Sierra Club Books.

Otto, S. & Pensini, P. (2017, Nov.). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behavior. *Global Environmental Change,* 47, 88-94.

Palmer, J. (2003). Environmental education in the 21st century: Theory, practice, progress, and promise (2nd ed.). New York, NY: Routledge.

Pastor, M. & Morello-Frosch, R. (2018, Summer). Gaps matter: Environment, health, and social equity. *Generations*, 42(2), 28-33.

Payne, P. (1997). Embodiment and environmental education. *Environmental Education Research, 3*(2), 133–153.

Pellitier, L., Tuson, K., Green-Demers, I., Tuson, K., & Beaton, A. (1998). Why are you doing things for the environment? The Motivation Toward the Environment Scale (MTES). *Journal of Applied Social Psychology*, *28*(5), 437-468.

Petrinjak, L. (2011). Elementary teachers getting less time for science. National Science Teachers Association. Retrieved from http://www.nsta.org/publications/news/story.aspx?id=58727

Power, K., & Green, M. (2014). Reframing primary curriculum through concepts

of place. *Asia-Pacific Journal of Teacher Education, 42*(2),105-118.

Prince, M., & Felder, R. (2007). The many faces of inductive teaching and learning. *NSTA WebNews Digest: Journal of College Science Teaching*. Retrieved from https://www.nsta.org/publications/news/story.aspx?id=53403 .

Ray, J., Wei, K. M., & Barrett, D. (2013). Effect of experience-based school learning gardens professional development program workshop on teachers' attitudes towards sustainability education. *Journal of Sustainability Education, 5.*. Retrieved from: http://www.jsedimensions.org/wordpress/content/effect-of-experience-based-school-learning-gardens-professional-development-program-workshop-on-teachers-attitudes-towards-sustainability-education_2013_06/

Redman, E. (2013). Opportunities and challenges for integrating sustainability education into K-12 schools: Case study Phoenix, AZ. *Journal of Teacher Education for Sustainability, 15*(2), 5-24.

Reich, K. (2007). Interactive constructivism in education. *E & C/Education and Culture, 23*(1), 7-26.

Repko, A., Szostak, R., & Phillips Buchberger, M. (2017). *Introduction to interdisciplinary studies.* Thousand Oaks, CA: SAGE Publications.

Rickinson, M. (2001). Learners and learning in environmental education: A critical review of the evidence. *Environmental Education Research, 7*(3), 207-230.

Rieckenberg, C. (2014). *Sustainable environmental education: Conditions and*

characteristics needed for successfully integrated program in public elementary schools (Doctoral dissertation). Retrieved from Proquest. (Accession No. 3662736)

Robottom, I. (2004). Constructivism in environmental education: Beyond Conceptual Change Theory. *Australian Journal of Environmental Education, 20*(2*),* 93-101.

Rose, J. (2012). How to break free of our 19th-century factory-model education system. *The Atlantic*. Retrieved from https://www.theatlantic.com/business/archive/2012/05/how-to-break-free-of-our-19th-century-factory-model-education-system/256881/

Rossnerova, A., Pokoma, M., Sveccova, V., Sram, R., Topinka, J., Zolzer, F., & Rossner Jr., P. (2017). Review: Adaptation of the human population to the environment: Current knowledge, clues from Czech cytogrenetic and "omics" biomonitoring studies and possible mechanisms. *Mutation Research, 773,* 188-203.

Roy, A., Kihoza, P., Suhonen, J., Vesisenaho, M., & Tukiainen, M. (2014). Promoting proper education for sustainability: An exploratory study of ICT enhanced Problem Based Learning in a developing country. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 10*(1), 70-90.

Rupasinghe, T. P., Samarasekere, P. W., & Wijesinghe, S. (2017). *Inquiry based learning approach in introductory level science education.* Paper presented at the International Postgraduate Research Conference 2017, University of Kelaniya, Sri Lanka.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic

definitions and new directions. *Contemporary Educational Psychology. 25*, 54-67. Retrieved from http://ac.els-cdn.com/S0361476X99910202/1-s2.0-S0361476X99910202-main.pdf?_tid=0454266c-5d10-11e7-8896-00000aacb361&acdnat=1498771083_c3c78fb69eb2cc17457d26c5716435d6

Sakellari, M., & Skanavis, C. (2013). Environmental behavior and gender: An emerging area of concern for environmental education research. *Applied Environmental Education and Communication, 12*(2), 77-87.

Sargeant, J. (2012). Qualitative research part II: Participants, analysis, and quality assurance. *Journal of Graduate Medical Education, 4(1),*1-3.

Sass, W., Boeve-de Pauw, J., Donche, V., & Van Petegem, P. (2018). Why should I do something for the environment? Profiles of Flemish adolescents' motivation toward the environment. *Sustainability, 10*(7), 1-17.

Saylan, C., & Blumstein, D. (2011). *The Failure of environmental education (and how we can fix it).* Los Angeles, CA: The University of California Press.

Schwägerl, C. (2014). *The Anthropocene: The human era and how it shapes our planet.* Santa Fe, NM: Synergetic Press.

Sharma-Brymer, V., Brymer, E., Gray, T., & Davids, K. (2018). Affordances guiding Forest School practices: The application of the ecological dynamics approach. *Journal of Outdoor and Environmental Education, 21*, 103-115.

Skinner, E., Chi, U., & The Learning-Gardens Educational Assessment Group. (2012). Intrinsic motivation and engagement as "active ingredients" in garden-based education: Examing models and measures derived from self-determation theory. *The Journal of Environmental Education, 43*(1),16-36.

Simsekli, Y. (2015). An implementation to raise environmental awareness of elementary education students. *Procedia- Social and Behavioral Sciences, 191,* 222-226.

Singleton, J. (2015). Head, heart, and hands model for transformative learning: Place as context for changing sustainability values. *Journal of Sustainability Education,* 1-1. Retrieved from http://www.jsedimensions.org/wordpress/wp-content/uploads/2015/03/PDF-Singleton-JSE-March-2015-Love-Issue.pdf

Smith, G. (2002). Place-based education. Learning to be where we are. *Phi Delta Kappan, 83*(8), 584-594.

Smith, G. (2007). Place-based education: Breaking through the constraining regularities of public school. *Environmental Education Research, 13*(2), 189-207.

Smith, C., & Landry, M. (2013). Inquiry-based learning for early elementary students. *Science and Children, 50(6),* 59-63.

Smith, G., & Sobel, D. (2010). *Place- and community-based education in schools.* New York, NY: Routledge.

Smith, J., & Noble, H. (2014). Bias in research. *Evidence Based Nursing, 17*(4), 100-101.

Sobel, D. (2004). *Place-based education: Connecting classroom and community.* Barrington, MA: The Orion Society.

Sobel, D. (2008). *Childhood and nature. Design principles for educators.* Portland, ME: Stenhouse Publishers.

Somekh, B. (2006). *Action research: A methodology for change and development.* Maidenhead, UK: McGraw-Hill Education.

Starks, H., & Brown Trinidad, S. (2007). Choose your method: A comparison of

phenomenology, discourse analysis, and grounded theory. *Qualitative Health Research, 17*(10), 1372–1380.

Stevenson, R. (2007). Schooling and environmental education: Contradictions in purpose and practice. *Environmental Education Research, 13*(2),139-153.

Stokes, W. (2018). Jane Goodall: To really make a difference, act locally. *The Frisky*. Retrieved from https://thefrisky.com/jane-goodall-to-really-make-a-difference-act-locally/

Stone, M. (2012). Applying ecological principles. *Center for Ecoliteracy*. Retrieved from https://www.ecoliteracy.org/article/applying-ecological-principles

Stringer, E. (2014). *Action research*. Los Angeles, CA: SAGE.

Stromberg, J. (2013). What is the Anthropocene and are we in it? Smithsonian Magazine. Retrieved fromhttps://www.smithsonianmag.com/science-nature/what-is-the-anthropocene-and-are-we-in-it-164801414/

Switzer, C. (2014). Using Place-based inquiry to inspire and motivate future scientists. *Science Scope*, 37(5), 50-59.

Tracy, S. (2010). Qualitative quality: Eight "Big-Tent" criteria for excellent qualitative research. *Qualitative Inquiry, 16*, 837-851.

Taylor, R., & Allen, W. (2008). Changing household behaviours: Learning for urban sustainability. *The Innovation Journal: The Public Sector Innovation Journal, 13*(2), 1-16.

Thornburn, M., & Allison, P. (2017). Learning outdoors and living well? Conceptual prospects for enhancing curriculum planning and pedagogical practices. *Cambridge Journal of Education, 47*(1), 103-115.

Tilbury, D. (1995). Environmental education for sustainability: Defining the new focus of environmental education in the 1990s. *Environmental Education Research, 1*(2), 195-213.

Tilikidou, I. (2007). The effects of knowledge and attitudes upon Greeks' pro-environmental purchasing behavior. *Corporate Social Responsibility and Environmental Management, 14*,121–134.

Upadhyay, B., & DeFranco, C. (2008). Elementary students' retention of environmental science knowledge: Connected science instruction versus direct instruction. *Journal of Elementary Science Education, 20*(2), 23-37.

USDA (n.d.). Food loss and waste. U.S. Department of Agriculture. Retrieved from https://www.usda.gov/foodlossandwaste.

USDA (2013). U.S. Food Waste Challenge. United States Department of Agriculture: Office of the Chief Economist. Retrieved from https://www.usda.gov/oce/foodwaste/faqs.htm

van Merrienboer, J., & Sluijsmans, D. (2009). Toward synthesis of cognitive load theory, four-component instructional design, and self-directed learning. *Educational Psychology Review, 21*(1), 55-66.

Van Poeck, K., König, A., & Wals, A. (2018). Environmental and sustainability education in the Benelux countries: Research, policy and practices at the intersection of education and societal transformation. *Environmental Education Research, 24*(9),1234-1249.

Wattchow, B., & Brown, M. (2011). *A pedagogy of place: Outdoor education for a changing world.* Randwick, NSW: Monash University Publishing.

Williams, M., & Houseal, A. (2018). Composting: A problem, place, or project? Using the PBL trifecta (PBL3) in the classroom. *Science Scope, 41*(6), 36-44.

Williams, I., Rose, L., Raniti, M., Waloszek, J., Dudgeon, P., Olsson, C., …… & Allen, N. (2018). The impact of an outdoor adventure program on positive adolescent development: A controlled crossover trial. *Journal of Outdoor & Environmental Education, 21*(2), 207-236.

Windschitl, M., & Barton, A. C. (2016). Rigor and equity by design: Locating a set of core teaching practices for the science education community. In D. Gitomer & C. Bell (Eds.), *Handbook of Research on Teaching* (5th ed., 1099-1158). Washington, DC: American Educational Research Association.

Wooltorton, S. (2006). Ecological literacy ‘‘basic’’ for a sustainable future. In *Proceedings of the Social Educator's Association of Australia (SEEAA) National Biennial Conference*. Brisbane, Australia.

Woodhouse, J., & Knapp, C. (2000). *Outdoor education, environmental education and place-based education. ERIC Clearinghouse on Rural Education and Small Schools.* Charleston, WV: ERIC Clearinghouse

Wyles, K., Pahl, S., & Thompson, R. (2014). Perceived risks and benefits of recreational visits to the marine environment: Integrating impacts on the environment and impacts on the visitor. *Ocean and Coastal Management, 88,* 53-63.

Yates, K., Reefer, A., Robertson, D., Hubbard-Sanchez, J., Huss, J., & Wilder, M. (2018). Educators' perceptions of environmental education and professional development in teacher preparation programs. *Applied Environmental Education & Communication,* DOI: 10.1080/1533015X.2018.1451411

Yilmaz, N., & Taş, A. (2018). The effect of nature education program on the level of environmental awareness of the elementary school students from different socioeconomic status. *Universal Journal of Educational Research, 6*(9), 1928-1937.

Zandvliet, D. (2012). Development and validation of the place-based learning and constructivist environment survey (PLACES). *Learning Environments Research, 15*(2), 125-140.

APPENDIX A
CONSENT FORM

UNIVERSITY OF SOUTH CAROLINA

CONSENT TO BE A RESEARCH SUBJECT

EDUCATION FOR SUSTAINABILITY: THE EFFECTIVENESS OF A PROJECT BASED ENVIRONMENTAL EDUCATION UNIT IN FOOD WASTE REDUCTION ON THE ECOLITERACY OF 4TH GRADE STUDENTS

KEY INFORMATION ABOUT THIS RESEARCH STUDY:

Your child is invited to volunteer for a research study conducted by Mrs. Bree Lauffer. I am a doctoral candidate in the Department of Education at the University of South Carolina. The University of South Carolina, Department of Education is sponsoring this research study. The purpose of this study is to examine the impact that an inquiry based environmental education approach will have on the environmental awareness level of fourth grade students in a school located in a southeastern state. This study is being conducted at Okatie Elementary in the STEM Lab and will involve approximately 10 volunteers.

This form explains what the students will be asked to do. Please read it carefully and feel free to ask questions before you make a decision about participation.

PROCEDURES: If you agree to allowing your child to participate in this study, they will do the following:

1. Complete a questionnaire about attitudes about the environment and sustainability practices. Complete a lunch waste inventory.
2. In the STEM lab, participate in the outdoor experiences and composting experiences designed to increase their ecoliteracy.
3. Complete post questionnaires, interviews, and waste inventories to help measure effectiveness of sustainability unit.
4. Have their interview recorded in order to ensure the details provided are accurately captured.

DURATION: Participation in the study involves 8 visits over a period of 10 weeks. Each study visit will last about 50 minutes and will be conducted during the regular Related Arts block.

IT IS VOLUNTARY: Participation in this study is voluntary. Your child is free not to participate, or to stop participating at any time, for any reason without negative consequences. Participation, non-participation, and/or withdrawal will not affect your child's grades in the STEM Lab.

IT IS ANONOYMOUS AND CONFIDENTIAL: The questionnaires and all information related to this study will be kept confidential and anonymous (no names will be recorded and/or attached to the forms or data—Students cannot be identified).

BENEFITS: Taking part in this study may benefit your child personally as it looks to find ways to better connect students to their environment. This research also seeks to help educators understand the effects of including ecological literacy components on student attitudes and performance levels.

Potential Risks: There are no known risks of physical harm to your child. Your child will not have to answer any questions unless s/he wants to.

For Further Information: Beginning March 13th, a copy of the survey will be available for previewing by contacting Mrs. Bree Lauffer at Bree.lauffer@beaufort.k12.sc.us o
If you do not want your child to participate, please sign and return to me by Friday, March 8, 2019.

_____

Name of Child_____

Yes, I would like my child to participate: _____

Parent/Guardian signature Date

No, I do not want my child to participate: _____

Parent/Guardian signature Date

SPANISH CONSENT FORM

UNIVERSIDAD DE CAROLINA DEL SUR

CONSENTIMIENTO PARA SER UN TEMA DE INVESTIGACIÓN
EDUCACIÓN PARA LA SOSTENIBILIDAD: LA EFICACIA DE UNA UNIDAD DE EDUCACIÓN AMBIENTAL BASADA EN UN PROYECTO EN LA REDUCCIÓN DE DESECHOS ALIMENTARIOS EN LA ALFABETIZACION DE ECOLOGIA DE ESTUDIANTES DE 4º GRADO

INFORMACIÓN CLAVE SOBRE ESTE ESTUDIO DE INVESTIGACIÓN:
Su hijo(a) está invitado a participar como voluntario en un estudio de investigación realizado por la Sra. Bree Lauffer. Soy una candidata doctoral en el Departamento de Educación de la Universidad de Carolina del Sur. El Departamento de Educación de la Universidad de Carolina del Sur patrocina este estudio de investigación. El propósito de este estudio es examinar el impacto que tendrá un enfoque de educación ambiental basado en la investigación en el nivel de conciencia ambiental de los estudiantes de cuarto grado en una escuela ubicada en un estado del sureste. Este estudio se está llevando a cabo en la Esculea Primaria Okatie en el laboratorio STEM e involucrará a aproximadamente 10 voluntarios.

Este formulario explica lo que se les pedirá a los estudiantes que hagan. Léalo detenidamente y no dude en hacer preguntas antes de tomar una decisión sobre la participación.

PROCEDIMIENTOS:
Si acepta permitir que su hijo(a) participe en este estudio, ellos harán lo siguiente:

1. Completar un cuestionario sobre las actitudes sobre el medio ambiente y las prácticas de sostenibilidad. Completar un inventario de residuos/deshechos de almuerzo.
2. En el laboratorio STEM, participe en las experiencias al aire libre y en las experiencias de compostaje diseñadas para aumentar su alfabetización de Ecología.
3. Complete post-cuestionarios, entrevistas e inventarios de desechos para ayudar a medir la efectividad de la unidad de sostenibilidad.
4. Haga que se grabe su entrevista para garantizar que los detalles proporcionados se capturan con precisión.

DURACION:
La participación en el estudio implica 8 visitas durante un período de 10 semanas. Cada visita de estudio durará aproximadamente 50 minutos y se llevará a cabo durante el bloque regular de Artes relacionadas

ES VOLUNTARIO:
La participación en este estudio es voluntario. Su hijo/a es libre de no participar o de dejar de participar en cualquier momento, por cualquier motivo y sin consecuencias negativas. La participación, la no participación y / o el retiro no afectarán las calificaciones de su hijo/a en el laboratorio STEM.

ES ANONIMO Y CONFIDENCIAL:
Los cuestionarios y toda la información relacionada con este estudio se mantendrán de forma confidencial y anónima (no se registrarán ni adjuntarán nombres a los formularios o datos; los estudiantes no se pueden ser identificados).

BENEFICIOS:
Participar en este estudio puede beneficiar a su hijo/a personalmente, ya que busca formas de conectar mejor a los estudiantes con su medio ambiente. Esta investigación también busca ayudar a los educadores a comprender los efectos de incluir componentes de alfabetización ecológica en las actitudes de los estudiantes y los niveles de rendimiento.

Riesgos Potenciales
No se conocen riesgos de daño físico a su hijo/a. Su hijo/a no tendrá que responder ninguna pregunta a menos que quiera.

Para Mayor Información:
A partir del 13 de Marzo, una copia de la encuesta estará disponible para una vista previa contactando a Mrs. Bree Lauffer [redacted]

Si no desea que su hijo (a) participe, por favor fírmelo y devuélvalo antes del viernes 8 de Marzo de 2019.

_____

Nombre del niño(a)_____

Sí, me gustaría que mi hijo(a) participe:

_____
Firma del padre / tutor

Fecha

No, no quiero que mi hijo(a) participe:

_____
Firma del padre / tutor

Fecha

APPENDIX B

ASSENT FORM

UNIVERSITY OF SOUTH CAROLINA
ASSENT TO BE A RESEARCH SUBJECT

EDUCATION FOR SUSTAINABILITY: THE EFFECTIVENESS OF A PROJECT BASED ENVIRONMENTAL EDUCATION UNIT IN FOOD WASTE REDUCTION ON THE ECOLITERACY OF 4TH GRADE STUDENTS

I am a researcher from the University of South Carolina. I am working on a study about environmental education and I would like your help. I am interested in learning more about how an outdoor classroom and composting experiences effect your attitudes and actions toward the environment. Your parent/guardian has already said it is okay for you to be in the study, but it is up to you if you want to be in the study.

If you want to be in the study, you will be asked to do the following:
• Answer some questions about your attitudes toward the environment
• Meet with me individually and talk about the environment. The talk will take about 10 minutes and will take place at the end of the study.

Any information you share with me will be private. No one except me (will know what your answers to the questions.

You do not have to help with this study. Being in the study is not related to your regular class work and will not help or hurt your grades. You can also drop out of the study at any time, for any reason, and you will not be in any trouble and no one will be mad at you.

Please ask any questions you would like to about the study. Signing your name below means, you have read the information (or it has been read to you), and that your questions have been answered in a way that you can understand, and you have decided to be in the study. You can still stop being in the study any time. If you wish to stop, please tell the researcher or study team member.

Print Name of Minor	Age of Minor
Signature of Minor	Date

APPENDIX C

LESSON PLANS

50 Min. Lesson	**Overall Lesson Objective:** **SW=Students will TW=Teacher will**	**Measurement tool:**
1 Week Prior to Unit	*Pre-assessments:* SW complete *Environmental Awareness Surveys* as baseline data before intervention begins. SW also quantify cafeteria waste by completing the *Waste Log* every day for 5 days. Cafeteria waste for the fourth-grade lunch block will also be weighed in pounds for pre-intervention data. TW create bulletin board in the cafeteria to display data once it is analyzed in the 3rd Lesson.	***Environmental Awareness Survey** ***Cafeteria Waste Log**
Lesson 1	*What is ecoliteracy? How can I be a more ecoliterate person?* *Lesson seeks to activate the social and emotional ecoliteracy levels in the students by introducing them to the idea of nested systems and enlighten them on their role they play in a complex, interconnected universe. Outdoor exploration will also be used to attempt to connect students to nature and influence their appreciation of it.* TW first read to the class *You are Stardust* by Elin Kelsey. SW reread the book with small groups. Groups are then tasked to pick out their favorite page. For instance, a group might select the following section of the book: "From ocean to sky to land and back again, the same water has been quenching thirsts for millions of years." Group will discuss and then write why this page was most meaningful to them. What mood the author was trying to convey on this page? And any questions they generated from the text on the page. Using the illustrations from the book as inspiration, students will then collaboratively work together to use natural materials found outside to create a scene that represents their favorite part of the book and the theme or emotion that went with it. TW take pictures of final scenes to be displayed along with the groups writing responses for the bulletin board to display student's appreciation and relationship with nature. Students will also glue pictures into their Nature journals the next week to remind them of the nested systems that exist between them, their classmates, and the greater world. SW conclude the lesson by bringing a piece of nature (a stick) back with them to the classroom. This will then be used to bind their nature journals together.	***Exit Slip** ***Student Artifacts** *** Teacher Reflective Journal** ***Field Notes**
Lesson 2	*What is ecoliteracy? How can I be a more ecoliterate person?* *In this lesson, activities seek to increase student's understanding of the cycles that sustain life in nature. Outdoor exploration in the trees in the back of the school property will be utilized to bring lessons in the book to life.* Before class goes outside, students will glue the Backyard Bird List into their journals. TW instruct them that from now on, they will be looking to check these birds off their list every time they conduct an outdoor activity. TW highlight her favorite bird, the Carolina Chickadee, and play its two most common songs from the internet. TW introduce the lesson by asking the question: Does nature waste? TW read *A Log's Life* by Wendy Pfeffer which follows the life of a log as it shelters and nurtures a variety of organisms. The setting of the story is in the forest and throughout the book it showcases the web of relationships that exist between a live oak and a variety of organisms. Since there is a live oak tree behind the school, this setting will be utilized to enhance the message of the book.	***Exit Slip** ***Student Artifacts in Student Nature Journal** *** Teacher Reflective Journal** ***Field Notes**

	After reading the book outside under the tree, SW have a better understanding of the cycles in nature that help sustain life and cause other species to maintain a "zero waste" lifestyle. With their journals, the class will then conduct a nature scavenger hunt, looking for signs of recycling and interdependency amongst all organisms in the forest. During this time, students will be looking to identify both vertebrates and invertebrates and document other examples of cycles that sustain life on our school grounds. TW find a log/stick and pull the bark to show the signs of organisms working to recycle it back into soil. TW also guide students to the big hole in the middle of the forest with a mound of soil next to it. SW stand in it to infer what might have happened here. TW ensure that students understand that this was once where a tree stood. TW also guide the class in predicting which way the tree fell based on their understanding of the cycles of nature from the book. (The roots create the large mound after it is broken down.) TW lead a class discussion: How stable is this cycle? Are there any forces in the world that could threaten this or another part of the cycle?	
Lesson 3	*What is ecoliteracy? How can I be a more ecoliterate person?* *In this lesson, students will understand the impacts that their actions have on the overall cafeteria waste by charting and evaluating their lunch waste. Overall trends will be studied, followed by brainstorming what should be done.* Class will begin by asking the question again: Does nature waste? SW provide examples of how nature does not waste. SW calculate the total items wasted from the lunch room. SW look for trends of what is thrown away the most. What do we see about trends between home lunches and school lunches? TW guide students to action plans based on the ideas generated from Lesson 3. Specifically, SW begin steps for implementation of composting in the school. SW, with the teacher's guidance, create strategies for procedures and rules for sorting food for composting in the cafeteria and articulate ways to reduce wasted food. SW create posters to add to the cafeteria with messages for the other grade levels as they look to start to compost in the cafeteria in the next couple weeks.	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**
Lesson 4	*What is ecoliteracy? How can I be a more ecoliterate person?* *In this lesson, students will understand ecoliterate behaviors found across the country and brainstorm ways in which students can act in the local setting.* TW pose question: Can we make a difference at the local level? How do we allow wasted food to keep its value? TW utilize the web-based resource NEWSELA to provide differentiated reading levels for the students. Students will read one of the articles in partners: -The Washington Post's *A student with an idea helps America fight food waste, one click at a time* -Orlando Sentinel's *Elementary' s "share tables" keep unwanted lunch food out of trash* Or Cengage Learning's *Is it possible to create zero waste?* And then summarize the findings in small group settings. SW then participate in creating a classroom *Twitter* feed. As the class is participating in this activity, TW play bird songs from the forest: https://www.youtube.com/watch?v=XxP8kxUn5bc SW create a *Tweet* by either summarizing something in the article, stating something that came to mind while they were reading, or expressing their feelings about our ecoliteracy unit so far. SW then post around the room. SW walk around to read the posts. After a couple of minutes, SW take post it notes to respond to 3 people. Hashtags and common themes will link the posts. They will stay up for the other classes to read and respond. Whose will go viral?	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**

	Groups will than brainstorm ways in which we could become more ecoliterate in the cafeteria. Outdoor Exploration: Last 5 minutes, SW learn how to complete a leave rubbing with a crayon and how to classify a leaf as either pinnate or palmate. SW then find one of each, add them to their nature journal, before having to go back inside.	
Lesson 5	<u>*Vermiculture & Continued Experiment Data Collection*</u> *Lesson will introduce students to the wonders of decomposers. Hands on exploration in the classroom will help students understand the physical characteristics that help worms survive and learn about the vital role they play in a sustainable "zero waste" lifestyle.* *A Second outdoor compost pile will be set up and PH levels and temperatures recorded daily over the next four weeks.* TW pose the questions: What does it mean to be an ecoliterate person? TW introduce another practice of an ecoliterate individual: empathy for all forms of life. SW discuss what they already know about worms. TW make sure to highlight the lack of bones and exoskeletons. Therefore, this requires gentle handling of the organism. TW pose the question: Are worms important? Are they as important as humans? SW engage in exploration while students recognize the differences between physical characteristics of the worm and other animals they are familiar with. TW guide their exploration to ensure that students understand that worms are invertebrates. SW label parts of a worm in their nature journals and deviser the physical characteristics that help them obtain their needs for survival (no eyes or nose…but can still sense light and get oxygen from their skin; mouth and the prostomium flap that pushes in food; etc.). SW then return the worms back into their home. Here, SW make observations of what they see (pieces of fruits and veggies, shredded up pieces of paper, newspaper, etc.). TW pose the question again: Are worms important? So that students can think about it while they watch worms in fast forward. Watch video to see the work of a worm over the course of 20 days. <u>https://www.youtube.com/watch?v=n9Mnf9ysNSs</u> What ingredients did we see in the compost bin in the video? Were they similar to what we saw in our bin? Why do you think each component of the worm compost bin is important? Think back to what those green bins smell like if we have them sit for a couple of days without emptying them??? TW guide them through the discovery that both "brown" (paper, leaves, sticks, etc.) and "greens" (fruits and veggies) help make the perfect recipe for fertilizer for our soil. TW use a picture of their first day in the forest during lesson 1. If an apple falls off the tree, is it only apples all over the ground? (leaves and sticks, the browns, are there as well). Using nature as our mentor, we can make the perfect additive for our garden. TW explain to the class that they will now help set up a new compost pile by our garden. SW first collect a few sticks to add to the bottom of our pile. Then, we will add some leaves (previously collected and stored in a container), add our "greens" from our compost pile, and top it with more leaves to complete the first layer. TW then explain how to read the measuring tool. Fertility levels, PH levels, and temperature will be measured and recorded for the next 4 weeks. SW observe and measure the various composting piles. Data will contribute to an overall class chart that will track the PH levels and temperatures of the compost over a 4 week. SW evaluate the data each week and learn about the science behind the temperature changes. SW also measure under our loquat tree on the school campus. Fertility levels will be at 0. Temperatures will be lower than in the compost pile. SW make observations to infer whether poor soil is effecting the overall health of the plant (ex: black spots on the leaves). Established compost pile will have much higher fertility levels. TW pose the question:	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**

	What can we do to help this tree out? How could we increase the fertility levels in the soil? TW create a large grid on large chart paper for data collection over the next four weeks. SW evaluate the data each week and learn about the science behind the temperature changes.	
Lesson 6	<u>*Classification of Plants, Plant Needs & Continued Experiment Data Collection*</u> *Students will be exposed to the effects that compost has on the growth and health of a plant. Student should understand the overarching theme at the end of the lesson: A lack of nutrients may make plants and/or animals experience stunted growth and make them vulnerable to sickness. Lesson should expose students to the benefits of composting (waste reduction for landfills and adding nutrients to the soil).* *As they are searching for indications of healthy vs. sick plants, students will use what they know about leaves (pinnate vs. palmate) and shapes of flowers to classify the plants in the school garden. Students will also discover the interdependence that exists between our flowering plants and pollinators in the animal kingdom.* TW again explain how to read the measuring tool. Fertility levels, PH levels, and temperature will be measured and recorded for the next 4 weeks. What are the trends that we see so far in our data? TW explain to the class that today when they go out to complete their measurements they will also be looking for clues to help better infer how our plants are looking to survive. Review what we have previously talked about in regards to the animal kingdom. First question to being classifying animals is Do they have bones? (invertebrates vs. vertebrates). Both major groups of Animals have to constantly worry about eating or being eaten. No part of what they do or how they look is by coincidence and with a good science brain you can make some pretty good inferences as to how the look to survive. What does it mean if they have webbed feet? Sharp teeth? Eyes on the side of their head? Colors of yellow and/or red? TW explain that many people, including adults, don't stop to look at the many clues that plants will give us to help us better understand their daily battle for survival. What is the first question we have to ask to begin classifying plants? Does it make a flower? Flowering plants are totally dependent on the animal kingdom for survive. TW explain that flowering plants produce a nectar so that pollinators will come to drink it. When they do, a little bit of pollen will get stuck. When they have gone to the next flower to keep drinking, a little might fall off. We have cross-pollinated and now we can produce a seed! TW use the analogy of trick or treating. When you go from house to house, what are you looking for? Sweet treats! Are you paying attention to the fact that a little stick or dirt was stuck to your shoe and you dropped it off at a house 3 doors down? Just like the person at the house has to spend some time (and some hard-earned dollars) to get the candy for you to get, plants have to exert a lot of energy to make the nectar. It is precious and so they want to make it count. Some plants have decided that they only want to rely on specific pollinators for survival. Just like not all animals eat mice, too much competition! So, some special clues help us see who they are trying to attract. Just like sharp teeth tell us that the animal eats meat, some flowers signal that they only want one type of pollinator. TW pose the question: Who are some pollinators? TW tell them about some very unique facts about hummingbirds that might give us some clues about what plants might be trying to attract them: Hummingbirds have to drink twice their weight in nectar a day to survive. Hummingbirds are the only pollinators that can drink while flying. Bees and butterflies need to land in order to drink from the flower. Hummingbirds can see red. Bees are red-blind so a red flower just looks like a leave to them. TW instruct the students to take 10 minutes to hunt for flowers in the outdoor area that signal that they are dependent on a hummingbird or butterflies and bees. They will	***Exit Slip** ***Field Notes** ***Teacher Reflective Journal** ***Student Nature Journals**

	draw a picture to add to their journal and label the two organisms in the interdependency. Then, TW review the tube shape and color of hummingbird flowers and the landing pad for butterflies and bees along with pinnate and palmate leaves. SW then be assigned 2 rocks that either in groups or individually must be placed by the correct plant in the garden. SW use the IPad to help classify. (For example, a student must search for a picture of a green pepper leaf and its flower to see if they could find the same plant in the garden). They will place the rock next to the plant and then have the teacher check if they are correct.	
Lesson 7	*The Science Behind Composting and Continued Data Collection in Compost Pile:* *Lesson objectives look to help grow the cognitive levels in the individuals of the biodiversity found in the compost piles and science behind composting. Outdoor compost piles will be set up and PH levels and temperatures recorded daily over the next four weeks.* *Students will also use writing and artistic expression to display their connectedness and appreciation of nature.* Composting can not only be effective in waste reduction but can also be helpful in climate change. https://www.youtube.com/watch?time_continue=1&v=nvAoZ14cP7Q Images of Compost Food Webs will be utilized to helps students the (See Appendix I & J) Hampton County (2012) Recycling and Solid Waste District: Food Web of the Compost Pile NYC Compost Project (n.d.): Decomposer Food Chain https://www1.nyc.gov/assets/dsny/docs/tip-sheet-decomposer-id-cpts-id-f.pdf TW help students prepare petri dishes for the microscope and utilize hand lens for quick SW learn about the haikus and how they traditionally focus on nature. TW then guide students through a quick review of the themes of the unit: connecting with nature, exploring how nature cycles matter and energy, and the dependency that plants have on organisms like worms, hummingbirds, bees, and butterflies. SW then be asked to take a walk outside to find inspiration for their poetry. Water color markers will be used to add illustrations to their literature.	***Student interviews will occur in the morning during the week of Lesson 7.** ***Student Nature Journals**
1 Week after intervention	SW complete *Environmental Awareness Surveys* as measurement tool for intervention on students' environmental awareness and ecoliteracy levels. SW also quantify cafeteria waste by completing the *Waste Log* every day for 5 days. Cafeteria waste for the fourth-grade lunch block will also be weighed in pounds for post-intervention data to compare with pre-intervention data. SW continue monitoring the compost piles after the intervention. SW also continue to measure PH and temperatures to recognize when bacteria actively working in the pile.	***Environmental Awareness Survey** ***Cafeteria Waste Log**

APPENDIX D:

STANDARDS ALIGNED WITH ECOLITERACY UNIT ON WASTED FOOD

50	ELA Standards Addressed	Math Standards Addressed	Science Standards Addressed	Materials needed	Ecoliteracy Skill:	Lesson Objectives
1 Week Prior		4.NSBT.4 Fluently add and subtract multi-digit whole numbers using strategies to include a standard algorithm		*Cafeteria Waste Log;* *MTES & Envir. Awareness Survey*		
Lesson 1	ELA Standards 4.RL.9.2 Explain how the author's choice of words, illustrations, and conventions combine to create mood, contribute to meaning, and emphasize aspects of a character or setting. 9.1 Identify and explain how the author uses imagery, hyperbole, adages, or proverbs to shape meaning and tone. 1.4 Engage in focused conversations about grade appropriate topics and texts; build on the ideas of others, pose specific questions, respond to clarify thinking, and express new thoughts. 13.1 Engage in whole and small group reading with purpose and understanding 6.1 Determine the development of a theme within a text; summarize using key details.		4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns. 4.L.5B. Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.	*You are Stardust* by Elin Kelsey Camera	*Understanding how nature sustains life* *Outdoor Exploration* *Nested Systems and Relationships* *Community Building*	*Lesson seeks to activate the social and emotional ecoliteracy levels in the students by introducing them to the idea of nested systems.* *Students will analyze the author's craft and how literary text and illustrations created an emotion.* *Work in partners to create a piece of art from objects found in nature.*

Lesson 2	4.RI.6.1 Summarize multi-paragraph texts, using key details to support the central idea. 6.1 Determine the development of a theme within a text; summarize using key details.		*4.L.5A.1 Obtain and communicate information about the characteristics of plants and animals to develop models which classify plants as flowering or nonflowering and animals as vertebrate or invertebrate.*	*A Log's Life* by Wendy Pfeffer	*Nested Systems* *Cycles* *Nature Appreciation/ Outdoor Exploration*	*In this lesson, activities seek to increase student's understandin g of the cycles that sustain life in nature. Outdoor exploration in the trees in the back of the school property will be utilized to bring lessons in the book to life. SW be introduced to the idea of "zero waste".*
Lesson 3	Standard 4: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.	4.NSBT.4 Fluently add and subtract multi-digit whole numbers using strategies to include a standard algorithm	4.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.	Data compiled from cafeteria *Waste Logs*; Harvest Public Media (2014) video	*Making the invisible visible;* *Anticipating unintended consequences*	*In this lesson, students will understand the impacts that their actions have on the overall cafeteria waste by charting and evaluating their lunch waste. Overall trends will be studied, followed by brainstormin g what should be done.*

Lesson 4	4.RI.6.1 Summarize multi-paragraph texts, using key details to support the central idea. 4.RI.8 Interpret and analyze the author's use of words, phrases, text features, conventions, and structures, and how their relationships shape meaning and tone in print and multimedia texts. 4.C.3.1 Compare and contrast how ideas and topics are depicted in a variety of media and formats. 13.1 Engage in whole and small group reading with purpose and understanding. 13.2 Read independently for sustained periods of time to build stamina. 13.3 Read and respond according to task and purpose to become self-directed, critical readers and thinkers.	4.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.	NEWSELA's leveled articles for food waste Data compiled from cafeteria *Waste Logs*; Harvest Public Media (2014) video Greenhouse Gas Calculator https://watchmywaste.com.au/food-waste-greenhouse-gas-calculator/	*Making the invisible visible;* *Anticipating unintended consequences*	*In this lesson, students will understand the impacts that their actions have on the overall cafeteria waste by charting and evaluating their lunch waste. Overall trends will be studied, followed by brainstorming what should be done.*

Lesson 5		4.NSBT.4 Fluently add and subtract multi-digit whole numbers using strategies to include a standard algorithm 4.NSBT.5 Multiply up to a four-digit number by a one-digit number and multiply a two-digit number by a two-digit number using strategies based on place value and the properties of operations 4.ATO.2: Solve real-world problems using multiplication (product unknown) and division (group size unknown, number of groups unknown).	4.L.5B. Conceptual Understanding: Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.	Composting Bins; Worms Soil Reader for Fertility, PH, and temperature	*Embracing sustainability as a community practice* *Biodiversity*	*Lesson will introduce students to the wonders of decomposers. Hands on exploration in the classroom will help students understand the physical characteristics that help worms survive and learn about the vital role they play in a sustainable "zero waste" lifestyle. A Second outdoor compost pile will be set up and PH levels and temperatures recorded daily over the next four weeks. Student should understand the overarching theme at the end of the lesson: A lack of nutrients may make plants and/or animals experience stunted growth and make them vulnerable to sickness. Lesson should expose students to the benefits of composting (waste reduction for landfills and adding nutrients to the soil).*

Lesson 6		4.NSBT.4 Fluently add and subtract multi-digit whole numbers using strategies to include a standard algorithm	4.L.5B.1 Develop and use models to compare how humans and other animals use their senses and sensory organs to detect and respond to signals from the environment. 4.L.5A.1 Obtain and communicate information about the characteristics of plants and animals to develop models which classify plants as flowering or nonflowering and animals as vertebrate or invertebrate. 4.E.2B. Reading a thermometer	Soil Reader for Fertility, PH, and temperature	*Embracing sustainability as a community practice* *Nested Systems*	*In this lesson, student will explore the school grounds with a heightened awareness about nested systems that exist. They should understand the overarching theme at the end of the lesson: Plants and animals have an interdependenc y. Lesson should expose students to the natures clues that indicate how they are dependent on one another for survival.*
Lesson 7	12.1 Explain how a series of chapters, scenes, or stanzas fit together to provide the overall structure of a particular story, drama, or poem Standard 5: Incorporate craft techniques to engage and impact audience and convey messages Standard 6: Write independently, legibly, and routinely for a variety of tasks, purposes, and audiences over short and extended time frames. 5.2 Employ hyperbole, imagery, personification, idioms, adages, and proverbs when appropriate to convey messages.	4.NSBT.4 Fluently add and subtract multi-digit whole numbers using strategies to include a standard algorithm	4.L.5B. Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce. 4.S.1A.3 Plan and conduct scientific investigations to answer questions, etc. 4.E.2B. Reading a thermometer	Greenhouse Gas Calculator https://watchmywaste.com.au/food-waste-greenhouse-gas-calculator/	*Biodiversity* *Nature Appreciation/ Outdoor Exploration* *Nested Systems and Relationships* *Community Building*	*Lesson objectives look to help grow the cognitive levels in the individuals of the biodiversity found in the compost piles and science behind composting. Outdoor compost piles will be set up and PH levels and temperatures recorded daily over the next four weeks. Students will also use writing and artistic expression to display their connectednes s and appreciation of nature.*

APPENDIX E:

ENVIRONMENTAL AWARENESS SURVEY

(Adapted from Bogner, 2018; Artvinli & Demir, 2018; Conn. Dept. of Environmental Protection, 2002)

Cognitive Component:	Highly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Highly Agree (5)
The nutrients in food can be recycled.	1	2	3	4	5
Paper is biodegradable.	1	2	3	4	5
Plastic wrap should go into the compost.	1	2	3	4	5
Changing food into soil takes several weeks or months.	1	2	3	4	5
Worms are decomposers.	1	2	3	4	5
Decomposers in a compost pile need oxygen.	1	2	3	4	5
The center of a working compost pile is very cool.	1	2	3	4	5
Compost piles are always very smelly.	1	2	3	4	5
All living things (miro-organisms, plants, animals, and humans) rely on one another	1	2	3	4	5
Nature recycles.	1	2	3	4	5
Affective Component:	Highly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Highly Agree (5)
I don't believe my behavior has an effect on the environment.	1	2	3	4	5
It's not worth me doing things to help the environment if others don't do the same.	1	2	3	4	5
Because my contributions are small, I don't think that I am responsible for pollution.	1	2	3	4	5
I enjoy gardening.	1	2	3	4	5
Listening to the sounds of nature makes me more relaxed.	1	2	3	4	5
We do not need to set aside areas to protect endangered species.	1	2	3	4	5
Human beings are not more important than other creatures.	1	2	3	4	5
We should protect nature.	1	2	3	4	5

Behavioral Component:	Never	Sometimes	Always
I compost at home.	Never	Sometimes	Always
When I sort my lunch waste, I know what goes into the compost food barrel.	Never	Sometimes	Always
If I have leftover food after the lunch period, I save it to eat later.	Never	Sometimes	Always
I consciously watch or listen to birds.	Never	Sometimes	Always
I take time to watch the clouds pass by.	Never	Sometimes	Always
I turn off the lights that are left on.	Never	Sometimes	Always
I look forward to going outside.	Never	Sometimes	Always
I throw garbage on the street.	Never	Sometimes	Always
I pick up trash even if it is not mine.	Never	Sometimes	Always

Connectedness to Nature Survey (CNS)
(Adapted from Navarro, Olivos, & Fleury-Bahi, 2017)

Connectedness Component:	Highly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Highly Agree (5)
I often feel a sense of oneness with the natural world around me.	1	2	3	4	5
I think of the natural world as a community to which I belong.	1	2	3	4	5
I recognize and appreciate the intelligence of other living organisms.	1	2	3	4	5
I often feel disconnected from nature.	1	2	3	4	5
When I think of my life, I imagine myself to be part of a larger cyclical process of living.	1	2	3	4	5
I often feel part of the web of life.	1	2	3	4	5
Like a tree can be part of a forest, I feel embedded within the broader natural world.	1	2	3	4	5
My personal health is does not depend on the health of the natural world.	1	2	3	4	5

APPENDIX F

EXIT SLIPS LOCATED IN NATURE JOURNALS

DATE: _____

_____

_____

_____

_____

_____

_____

_____

_____

HOW DID YOU LIKE TODAY'S LESSON?

0	1	2	3	4	5	6	7	8	9	10
Hated!		Disliked		Just OK	Neutral		Liked	Enjoyed		Loved!

DID TODAY'S LESSON MAKE YOU FEEL MORE CONNECTED TO NATURE?

1	2	3	4	5
Definitely NO!	Somewhat No	Neutral	Somewhat Yes	Definitely Yes!

APPENDIX G

Name: _____

WASTE LOG

	Monday	Tuesday	Wednesday	Thursday	Friday
Where did your meal come from?	Cafeteria Home	Cafeteria Home	Cafeteria Home	Cafeteria Home	Cafeteria Home
Number of food items					
Why didn't you eat it?					
Number of plastic items					
Number of paper items					
Number of Styrofoam items					

APPENDIX H

STUDENT INTERVIEW PROTOCAL

Part 1: Background

1. Tell me a little bit yourself.
    a. What sort of personality do you have?
    b. What sorts of things do you enjoy doing outside of school?
    c. Tell me about your friends.
2. Describe yourself as a student.
    a. What would you say is your best subject in school? Why? What is your favorite subject? Why?
    b. What subject do you feel is your weakness? Why? Which subject is your least favorite?
    c. In science, how would you rate your ability on a scale of 1 to 10. Why?

Part 2: Environmental Awareness

1. What are the factors that pose a danger to our environment?

2. Can you give examples of the environmental practices done in your school?

3. How did the composting unit impact your ideas of the environment?

4. How did the ecoliteracy unit impact your opinions on "going outside" for class?

5. How did the ecoliteracy unit impact your opinions on the school garden?

6. What did you enjoy about the unit?

7. What did you not enjoy about the unit?

8. Should schools include lessons on environmental awareness and ecoliteracy?

APPENDIX I

FIELD NOTES

Date:	Student	Student Behavioral Engagement (✓ for on task behaviors) (- for off task behaviors)	Anecdotal Notes:

APPENDIX J

FOOD WEB OF THE COMPOST PILE

Hampton County (2012) Recycling and Solid Waste District

APPENDIX K

DECOMPOSER FOOD CHAIN

NYC Compost Project (n.d.)