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# From Seeds To Shoreline®: A Place-Based Approach To Impacting Student Engagement And Achievement

Molly Lloyd
*University of South Carolina - Columbia*

FROM SEEDS TO SHORELINE®: A PLACE-BASED APPROACH TO IMPACTING STUDENT ENGAGEMENT AND ACHIEVEMENT

by

Molly Lloyd

Bachelor of Arts
Georgia State University, 1996

Master of Arts
Gardner-Webb University, 2007

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Accepted by:

Yasha Becton, Major Professor

Suzy Hardie, Committee Member

Aisha Haynes, Committee Member

Chris Bogiages, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

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# ABSTRACT

*Place-based education* refers to pedagogy that connects student learning with the local environment and students' lives. Educators' preoccupation with standardized test scores have increased the disconnect between formal education and student's life experiences. Schools have developed systems of learning in isolated subjects through reading texts, listening to lectures, or watching videos rather than authentic, experiential learning. School districts have embraced a STEM (science, technology, engineering, and science) approach to education as a way of invigorating student learning. There are many approaches to integrating, hands-on, inquiry-based science lessons. As science PASS test scores have declined, educators are examining best STEM instructional practices. Two essential questions guided the research. What impact would the implementation of *From Seeds to Shoreline®*, a place-based educational program, have on student attitude toward learning science and student achievement? At the conclusion of an action research study, the teacher-researcher found: (1) an increase in pre and post assessments of student attitude and engagement in learning science, (2) an increase in test scores after the implementation of the *From Seeds to Shoreline®* program, (3) an appreciation for the historical approaches and pedagogical evolution of place-based education, and (4) an appreciation for place-based education as a method of instruction and learning which incorporates interdisciplinary learning, problem-based learning, immersive experiential learning, student centered learning, and a constructivist model of learning.

Key Words: place-based learning, STEM, interdisciplinary learning, problem-based learning, experiential learning, student-centered learning, constructivist model, social justice, action research.

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## LIST OF ABBREVIATIONS

CS2P ........................................................Connecting Schools to People & Place Program

EIC ........................................................................ Environment as an Integrating Context

ELL ........................................................................................ English Language Learner

ESOL.....................................................................................English as a Second Language

MAP ...................................................................................... Measure of Academic Progress

NAEP ..........................................................National Assessment of Educational Progress

NGSS ........................................................................Next Generation Science Standards

NCLB..............................................................................................No Child Left Behind

PASS ..................................................................... Palmetto Assessment of State Standards

PEEC..................................................... Place-Based Education Evaluation Collaborative

PISA...........................................................Program for International Student Assessment

RIT ..................................................................................................................Rasch Unit

RTI ..........................................................................................Response to Intervention

SDT ........................................................................................ Self-Determination Theory

SEER.............................................................State Education & Environment Roundtable

STEM.............................................................Science, Technology, Engineering, & Math

TIMSS.............................................Trends in International Mathematics and Science Stud

# CHAPTER ONE

# INTRODUCTION

Place-based education stands out as an alternative to the current standardized education era. Standardized test scores as the basis of student achievement have been the center of educational policy for several decades. Evidence of increased standardization of education is high-stakes tests, state mandated curricula based on national standards, and generic curricula and textbooks designed for students throughout the country (Sobel, 2005). Some educators and researchers are embracing place-based educational initiatives with the goal to connect learners, place, curriculum, and place (Gruenwald, 2003a; Smith, 2002b; Duffin, Chawla, & Sobel, 2005; Lloyd, Truong, & Gray, 2018).

Student science achievement has become a priority in school districts throughout the country (Kelley & Knowles, 2016). Over the last twenty years, the National Research Council (National Research Council, 1996, 2000, 2012) suggested science standards and objectives for students in Kindergarten through twelfth grades. There is general agreement among educators and researchers regarding the science concepts, standards, and objectives, or *what* students learn from science instruction (English, 2017; National Research Council, 2012; Stiles, 2016; Stevenson, 2007). What appears to be difficult to determine is *how* to best teach science to our students.

Many schools have implemented STEM (science, technology, engineering and math) education to develop students' critical thinking skills and to provide opportunities for students to explore and learn integrated subjects (Sias, Nadelson, Juth, & Seifert, 2017). Accordingly, educators must now determine how to implement STEM education across school contexts and curricula (English, 2017). According to Masters (2016), "subjects tend to be taught in isolation from each other, at a time when solutions to societal challenges and the nature of work are becoming increasingly cross-disciplinary" (p.6). Therefore, the challenge for educators is to determine how to effectively integrate subjects while maintaining specific content knowledge (English, 2017). In effort to improve STEM education in the classroom, educators may choose to examine their approach to full STEM integration.

A public educational reform movement based on essentialist curricula and methods is prominent in our country. Teachers and administrators are held accountable for student achievement as determined by standardized testing. Some critics argue that the focus dedicated to successful testing requires schools to "narrow their curriculum and their classroom practices" (Meier & Wood, 2004). However, STEM integration is recognized and emphasized as an alternative, interdisciplinary, educational solution to address the standardization of education, as well as many current environmental, economic, and social problems (Bryan, Moore, Johnson & Roehrig, 2015).

Rios and Brewer (2014) acknowledged there is agreement among educators that science should be taught using inquiry-based lessons which emphasize understanding of scientific content by actively questioning and engaging in science work. Numerous evidence-based STEM approaches have the potential for engaging and motivating students to collaborate, think critically, and solve complex problems (LaForce, Noble, & Blackwell, 2017; English, 2017; Kelley & Knowles, 2016). Specifically, problem-based learning is utilized in many schools throughout the country as an accepted and successful approach to integrating STEM education (LaForce, Noble, & Blackwell, 2017). One approach that takes problem-based learning to a higher level of inquiry, integration, and authentic learning is place-based education (Sobel, 2013). There is a natural transition from the problem-based learning approach to place-based education. Smith (2002b) noted place-based learning offers "a means to engender among students a sense of affiliation with their home communities and regions, develop problem-solving skills and the ability to collaborate with others, cultivate a sense of responsibility for the natural environment and the people it supports, and instill a recognition of their own capacity to be positive change-makers" (p. 586). Researchers provided studies which indicated positive results in increased student engagement and achievement as a result of place-based education initiatives (Carrier-Martin, 2003; Slade, Lowery & Bland, 2013; Smith, 2002a; Sobel, 2013; Sugg, 2015; Lloyd, Truong, & Gray, 2018).

## Problem of Practice

Multiple educational problems may be addressed with place-based education. Lloyd & Gray (2014) stressed that place-based education has substantial capability to positively impact student academic achievement, social development, and general well-being. Unfortunately, many elementary students have limited opportunities to engage in learning in a place-based, authentic, environmental setting (Rios & Brewer, 2014). In this era of high stakes testing and accountability tied to educational reforms, place-based education is often regarded as too risky and unpredictable an approach to incorporate into STEM instruction (Anderson, 2017). Additionally, out of nine educational approaches for teaching elementary STEM lessons studied, place-based learning was the least frequently implemented educational approach (Sias, Nadelson, Juth, & Seifert, 2017). Huckle &

Wals (2015) noted that the focus on international competitiveness and workforce preparation have encouraged educators to restrict curriculum and instruction. Research by Lloyd, Truong, & Gray (2018) showed that many school districts neglect to teach elementary students using integrated, hands-on, experiential environmental education programs.

Federal and state testing requirements affect curriculum and instruction (David, 2011; Blank, 2012; Fulmer, Tanas, & Weiss, 2018). A 2007 report indicated after the implementation of NCLB, 62% of all school districts, and 75% of districts identified as at-risk schools, increased language arts and math instruction time in elementary schools. Language arts instruction increased 47%, and math instruction increased 37%. Instructional time in other subjects, including science, social studies, the arts, and physical education decreased in those districts in the report (McMurrer, 2007). As schools devoted instructional time to administering state and national tests, resources have been typically taken away from science instruction. Interesting, innovative, and rigorous learning activities not directly related to achievement tests have often been dismissed or discouraged (Feinstein, 2009).

Based on comparison of international test scores, American students have lagged behind. This may indicate possible weaknesses in current science instruction in the U.S. (Killewald & Xie, 2013). For example, the 2015 Trends in International Mathematics and Science Study (TIMMS) indicated fourth grade students ranked eleventh in math and eighth in science out of 36 countries. Scores on the Program for International Student Assessment (PISA) have remained flat since 2000. On the 2015 test, American students ranked 23$^{rd}$ in science, 30$^{th}$ in math, and 24$^{th}$ in reading literacy out of 65 countries

(Serino, 2017). The average fourth grade science score on the National Assessment of Educational Progress (NAEP) increased 4 points from 2009 to 2015. However, nationally, only 38% of fourth grade students scored at or above the proficient level in 2015 (The Nation's Report Card, 2015).

A primary concern within the school specifically related to this study was the Palmetto Assessment of State Standards (PASS) science test showed a decrease of 14.7 points between the years 2009 to 2014 (Keefner, 2015). In addition to decreasing science test scores, there has been concern that students were not benefitting from research-based methods of instruction (Gillies & Rafter, 2017). Place-based education plays an important role in effectively motivating students (PEEC, 2010). Real world projects and problem-solving opportunities make learning relevant (Sias et al., 2017). Place-based education carried out in an outdoor classroom addresses a primary educational concern:

> "(T)he lack of connection between formal schooling and students' lives, a disconnect that makes learning an imposed chore rather than an opportunity to explore questions that arise from students' innate curiosity and desire to become competent and contributing members of their families and communities" (Smith, 2002a, p. 30).

After NCLB was implemented, a Journal of School Health study found that "40-60% of students are chronically disengaged from schools" (Gruenwald & Smith, 2008, p.74). This disconnection from school and learning has the potential to impact success in academic achievement, and limit success beyond school (Sobel, 2013).

The emphasis on reading and math instruction in elementary schools has reduced students' opportunity for authentic, inquiry-based instruction (Feinstein, 2009). Research collected by PEEC (2010) suggested problem-based learning experiences in an outdoor setting could lead to higher levels of student engagement as measured by attitude and motivation. Higher levels of student engagement could correlate to higher levels of student achievement related to fourth grade standards on nationally normed science achievement tests.

Place-based education programs occur in local environments and contexts, and the curriculum content usually depends on the location of the learning (Gray & Thomson, 2016). Smith (2002a) claimed that place-based environmental education curriculum and learning experiences organically arise from the "individual qualities of specific communities" (p.31). An example of a specific, local environment providing a rich context for learning is the salt marsh. Nearly 200,000 acres of salt marsh are in Beaufort County, South Carolina (Beaufort County Comprehensive Plan, 2017). This abundant salt marsh provides a natural and specific context for place-based environmental study. Because some of South Carolina's shoreline has lost important natural buffers and critical habitats within the salt marsh ecosystem, scientists from several state agencies developed the *From Seeds to Shoreline*® education program for K-12 science students (Bell, Binz, & Morganello, 2016). According to the program teacher manual, *From Seeds to Shoreline*® engages students as citizen scientists in restoring *Spartina alterniflora*, the dominant plant in the salt marsh. Students participate in hands-on science that addresses Next Generation Science Standards, serves the coastal community, and emphasizes environmental stewardship. The program provides an opportunity for students to learn a variety of lessons focusing on habitat, water quality, and saltmarsh ecology (Bell, Binz, & Morganello, 2016).

This inquiry-based, hands-on curriculum encourages students at coastal schools to learn about the importance of saltmarsh ecosystems and actively contribute to all steps in the restoration process: seed collection, germination, cultivation and planting *Spartina alterniflora* on the shoreline (Bell, Binz, & Morganello, 2016). Students learn science concepts utilizing authentic learning tasks as they study the saltmarsh ecosystem. Additionally, students may become more environmentally responsible and help their community which may lead to a more positive attitude and a higher level of engagement toward learning science (Bell, Binz, & Morganellos, 2016).

## Research Questions

To examine the effects of a place-based environmental education program on students' understanding and appreciation of science concepts, the following research questions were asked:

1. What impact does the *From Seeds to Shoreline*® curriculum, a place-based instructional program utilizing interdisciplinary, problem-solving, cooperative learning have on fourth grade students' engagement in learning science concepts.
2. What impact does the *From Seeds to Shoreline*® program have on student science achievement on science tests?

## Purpose of the Study

The purpose of this study was to evaluate to what extent a place-based education program impacted student attitude regarding science education and the impact on student achievement based on fourth grade science standards. The place-based education program used in this study was *From Seeds to Shoreline*®. The objectives of this study were twofold:

- Determine the effects of a place-based, outdoor, experiential environmental science program within the framework of problem-based, cooperative learning on students' knowledge about natural science;
- Evaluate effects of a place-based, outdoor, experiential, environmental science program on students' attitudes toward the environment and science.

Students learned about the importance of the salt marsh ecosystem and participated in all steps in the restoration process: seed collection, germination, cultivation, and planting *Spartina alterniflora* on the shoreline. *From Seeds to Shoreline*® is a year-long program in which students learned science by interacting with all aspects of growing and planting *Spartina alterniflora* in the Lowcountry salt marsh (Bell, Binz, & Morganello, 2016). An additional goal of this action research was to determine students' attitudes and interest relating to science instruction based on the *From Seeds to Shoreline*® program. The teacher-researcher examined whether an interdisciplinary, inquiry-based instructional process program that utilized more cooperative learning, deep scientific concept development in an outdoor setting provided students with a higher level of interest and engagement, and a more comprehensive understanding of science concepts.

Therefore, by grounding learning in the local community and environment, place-based education has the potential to engage and motivate students in higher-level learning, improve academic achievement, and foster citizenship and community connections. The goal of this study was to determine if the place-based educational program, *From Seeds to Shoreline*®, significantly changed students' engagement and academic achievement in science education.

## Theoretical Framework

This action research study examined place-based environmental curriculum design and the impact on student attitude and learning. Place-based environmental learning is a "broad, integrated approach that is interconnected with place, curriculum, and learners" (Lloyd, Truong, & Gray, 2018). Using the *From Seeds to Shoreline®* program, students actively learned through inquiry and problem-based methods, which are grounded in constructivist psychological theory. In the upcoming related literature review, the teacher-researcher thoroughly examined the theoretical framework on which place-based environmental education is built.

Place-based education is "the process of using the local community and environment as a starting point to teach…all subjects across the curriculum (Sobel, 2013, p. 11). Place-based education is a general term to describe "formal instructional programs that adopt local natural and cultural environments as the context for much of the students' educational experience" (Ernst & Monroe, 2004, p. 508). The focus of this dissertation is the examination of place-based education and its combination of a variety of instructional and learning methods and strategies. The place-based education approach serves as a framework for five specific learning models:

1. Interdisciplinary learning in which course content is connected to the local environment, such as the *From Seeds to Shoreline®* program, and the traditional lines between subject areas are blurred so that students may incorporate English-language arts, math, social studies, and art with science as they learn within their local environment;

2. Problem-based learning experiences in which learners are actively engaged in the learning process, questioning and solving problems, investigating issues, and finding solutions to problems. Students' work with the *From Seeds to Shoreline®* program is necessary and valued because the problem-solving is authentic;
3. Local environment where place is the central catalyst for experiential learning;
4. Student-centered learning to focus on the needs and perspectives of learners;
5. Constructivist model of learning where new learning experiences are based on previous activities which build on skills and concepts learned from past experiences. Reflection is an essential component of learning that takes place throughout the learning process (Ernst & Monroe, 2004; Sobel, 2013).

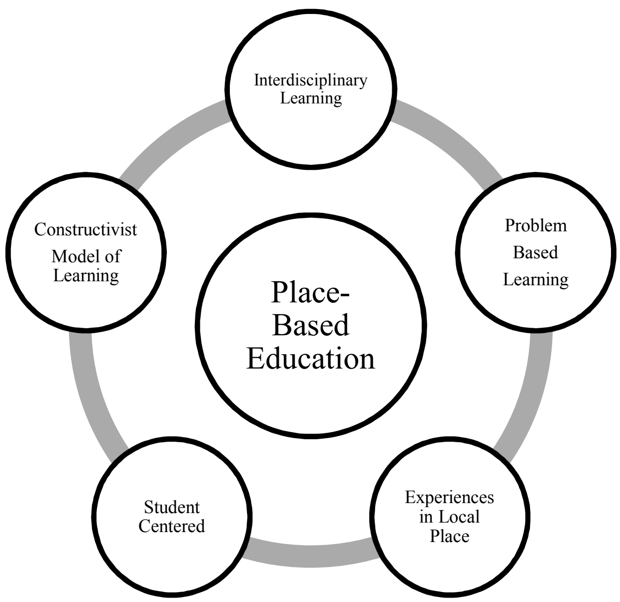


Figure 1.1 Place-based education learning characteristics

It is within this framework depicted in Figure 1.1 that authentic learning and engagement lead to increases in student academic achievement in all subjects (Ernst & Monroe, 2004; Sobel, 2013; Gruenewald, 2003a). Students gain a deeper understanding of science concepts when they learn science content in authentic settings (Switzer, 2014). Students may also be better able to transfer the knowledge to other situations, such as responding to questions on standardized tests, and solving complex real-life issues and problems (Ernst & Monroe, 2004).

Constructivist theory examines social, economic and political problems to encourage social change and foster social justice. Constructivist theory builds on the progressive educational philosophy advocated by John Dewey in which he attributed all education to experience (Dewey, 1938). Dewey and other constructivist theorists view learning as active and relevant, where teachers guide students to problem-solve with interdisciplinary inquiry. The *From Seeds to Shoreline®* program of learning allowed students to experience the saltmarsh on a field trip where they transplanted *Spartina alterniflora*. Field experience in which students made observations, conducted research, and gathered data, was the first opportunity for many students to visit the saltmarsh and sense the sights, smells, sounds, and textures of the marsh.

Within the constructivist framework based on Dewey's progressive theories, experiential education emphasizes the role experience plays in the learning process (Kolb, 1984). The experiential learning theory is "a holistic integrative perspective on learning that combines experience, perception, cognition and behavior" (Kolb, 1984, p. 21) which define the nature of experiential learning. According to Kolb (1984), "learning is the process whereby knowledge is created through the transformation of experience (Kolb, 1984, p. 38). Constructivism and experiential learning theory propose an active, hands-on approach to be more effective for promoting increases in content knowledge (Kolb & Fry, 1975; Jacobson, McDuff, & Monroe, 2006).

By integrating these five components of place-based education curriculum model into science instruction, teachers may help students develop problem-solving skills (Dieser & Bogner, 2016), better learn standards-based content knowledge (PEEC, 2010), learn about the environment in which they live, and become environmentally aware citizens (Bell, Binz, & Morganello, 2016). When students study and apply scientific content in a familiar environment, they have an opportunity to gain a deeper understanding of scientific concepts (Dieser & Bogner, 2016). The environment is a natural setting for authentic engagement and learning (Smith, 2002a). Figure 1.2 illustrates the theory of place-based environmental education as it relates to changes in teaching practices, increased student engagement, and improved student academic achievement.

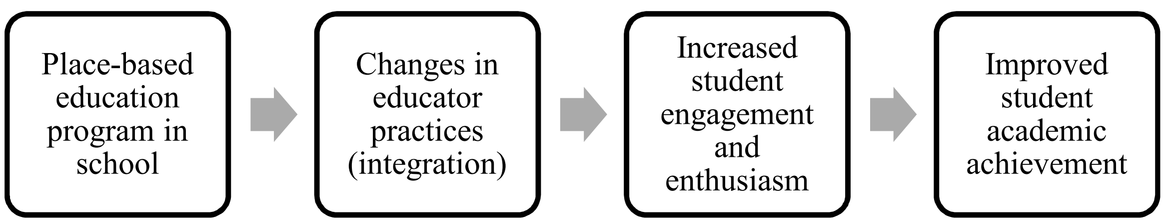


*Figure 1.2* Theory of place-based education process

As depicted in Figure 1.2, the theory of place-based education demonstrates the process of using local community and environment as the context to integrate learning experiences in subjects across the curriculum (Gillies & Rafter, 2017; Anderson, 2017). Programs are developed around the unique characteristics of a particular place and location. Changes in instructional practices, including integration and other research-based methods, lead to increased student engagement and enthusiasm, which in turn, results in improved academic achievement (Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014).

## Overview of Methodology

Action research empowers teachers to study a relevant topic such as effective elementary science instruction as it is simply a process of inquiring about problems and taking action to solve those problems within the classroom. (Pine, 2009). By researching place-based instructional practices and its impact on students' science engagement and achievement, the teacher-researcher determined its impact and effectiveness as an instructional approach for students (Bell, Binz, & Morganello, 2016).

The focus of this Dissertation of Practice was to analyze the impact of a place-based educational experience utilizing an authentic, problem-based curriculum in which the students participate in local, outdoor learning. The teacher-researcher utilized the *From Seeds to Shoreline®* program to provide science instruction to fourth grade students. Through the action research study, the teacher-researcher determined how place-based education impacted students' attitude toward learning science and their science achievement. This study investigated to what degree student engagement in learning about plant adaptation content and constructed knowledge were affected by place-based, environmental, outdoor, experiential instruction. Pre- and post-tests were utilized to determine the degree of difference in student level of interest in science lessons and knowledge of plant adaptation concepts.

The research was performed in a fourth-grade classroom, the schoolyard, and a local salt marsh. The school is a suburban school in the South Carolina low country. The twenty participants were fourth grade students in the teacher-researcher's classroom. The *From Seeds to Shoreline®* instructional program is comprised of ten lessons clustered into two units. The program was developed by Clemson University Extension, South

Carolina Department of Natural Resources, and the South Carolina Sea Grant Consortium to involve students in coastal schools in learning about the importance and conservation of the saltmarsh ecosystem while learning the South Carolina State Science Standards (Bell, Binz, & Morganello, 2016).

## Significance of the Study

Our environment, our natural resources and our economy are rapidly changing. Louv (2008), the author of *Last Child in the Woods*, asserted that our students must receive a more comprehensive science education to manage impending environmental challenges, such as clean air and water, to wildlife conservation and climate change. It is incumbent on educators to "empower students to become critical thinkers who can change the world and address environmental concern in ways not currently imaginable" (Louv, 2008, p. 16). While preschool and elementary children are naturally curious and engage in science and the natural world, their interest often transforms into apprehension or fear by middle school (Smith, 2002a). A recent study indicates there is a decline in children's participation and engagement in nature (Hunt, Stewart, Burt, & Dillon, 2016). Elementary years are an important time for students to acquire conceptual environmental knowledge (Louv, 2008). Mandated curriculum and national textbooks tend to focus on vocabulary and general science principles rather than inquiry-based, experiential learning. In this way, science education becomes "detached from the world rather than part of it" (Smith, 2002b, p. 588).

Place-based education integrates experiential, problem-based learning with local learning places (Sobel, 2013). This approach encourages students to develop an appreciation of their community and their impact on where they live. The *From Seeds to*

*Shoreline*® program stresses hands-on learning through problem-solving and experimental activities (Bell, Binz, & Morganello, 2016). Experiencing the environmental and natural sciences first hand allows students to develop and appreciate the content of each discipline. Students "learn by doing" rather than through reading, note-taking and rote memorization (Dewey, 1938). Students gain knowledge through experience, exploration, problem-solving and building on prior knowledge.

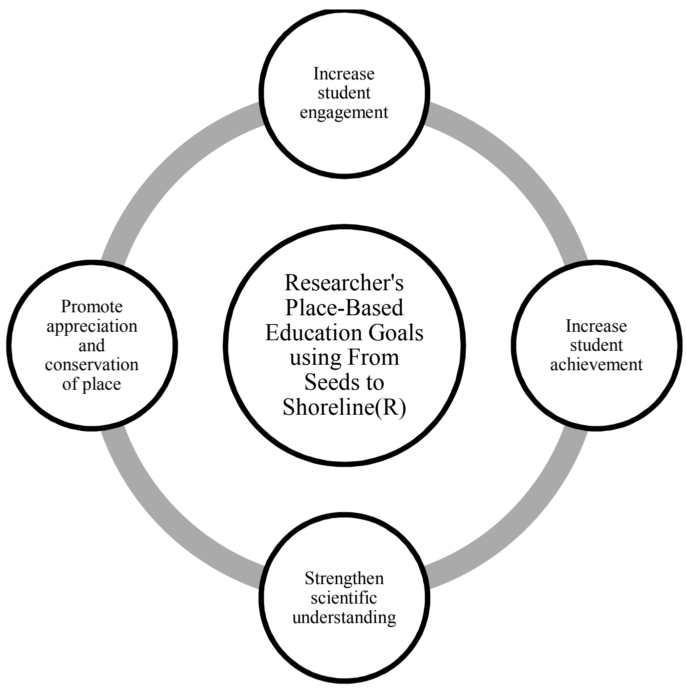


*Figure 1.3* Teacher-researcher goals of place-based education

As illustrated in Figure 1.3, there were four specific program goals set forth by the teacher-researcher implementing *From Seeds to Shoreline*®, a place-based educational program. The significance of the study was to address how the place-based education approach supports and aligns with the researcher's educational goals:

- provide measurable academic achievement in science;

- increase interest and enthusiasm about science-based learning;
- strengthen understanding of scientific methods, instruments, and technologies;
- promote appreciation and a sense of conservation and stewardship among students (Bell, Binz, & Morganello, 2016).

## Limitations of the Study

There were potential weaknesses in the action research study. Of primary concern to the teacher-researcher was the time limitation in the action research cycle. Only six to eight weeks were available to conduct the study. It was imperative that pre- and post-tests be administered during this brief instructional period. The lesson plans required ten days of outdoor instruction with one day devoted to a field trip to the saltwater marsh. In addition to planning adequate time to learn the content, the field trip was scheduled around optimal transplanting weather, the interval of the tide, and state testing.

The small sample size of twenty students posed a limitation. Generally, the larger the study and sample, the results are more reliable. A study with only twenty participants is difficult to scale (Mertler, 2014). Additionally, there was a lack of generalizability of research findings as the teacher-researcher guided students based on their specific knowledge of science content and their level of enthusiasm in participating. It may be challenging to overcome teacher-researcher bias which may decrease the validity of the action research study.

Possibly the greatest limitation to the study was the current school structure (Kelley & Knowles, 2016). The power of place-based education is its integrated and interdisciplinary methods. State standards, indicators, pacing guides, and class schedules dictated when concepts were taught in isolated class periods. While skilled teachers can integrate many components, it is challenging to empower students to fully participate in hands-on, inquiry-based, authentic problem-solving explorations in 45-minute blocks of time. Place-based education does not neatly align with the current school structure of separated disciplines, state-mandated curriculum, and standardized testing (Smith, 2002a).

## Overview of the Dissertation

The problem of practice identified was lack of opportunities for student engagement in meaningful science learning experiences and declining standardized test scores. While there has been a recent emphasis on STEM integrated education, it is necessary to determine the best approach for teaching science (Anderson, 2017). The teacher-researcher examined the impact place-based learning carried out in a local, outdoor environment to determine the impact of the *From Seeds to Shoreline*® program on student interest in learning science and their science knowledge and content achievement.

Chapter One of the dissertation provides context and a framework for the study of a particular problem with science engagement and achievement in the teacher-researcher's classroom. It also introduces and defines place-based education, a specific STEM instructional approach. Chapter Two provides a review of literature addressing research relating to the efficacy of place-based outdoor education, experiential learning, and problem-based learning. Chapter Three describes in detail the action research setting, methods, and methodological approach to the study. The findings and interpretations of the action research are analyzed in Chapter Four. Finally, Chapter Five addresses the implications of the study with recommendations for further research.

## Definition of Terms

*Action Research*: a participatory, cyclical research process in which the researcher collects and analyzes data to improve education by incorporating change (Mertler, 2014).

*Environment-based Education*: outdoor inquiry-based education where teachers help students develop critical thinking skills, become better problem solvers, learn content knowledge and become more environmentally responsible (Louv, 2008).

*Experiential learning*: a holistic integrative perspective on learning that combines experience, perception, cognition and behavior (Kolb, 1984).

*Inquiry-based Learning*: posing questions or problems to encourage students to learn through their own investigation (Powell & Wells, 2002).

*Outdoor Education*: experiential learning in, for, or about the outdoors and broadly refers to a range of organized activities that take place in outdoor environments (Rios & Brewer, 2014).

*Place-based Learning*: using the local community and environment as a starting point to teach concepts across the curriculum by emphasizing hands-on, real-world learning experiences (Sobel, 2013).

*Problem-based Learning*: student-centered pedagogy in which students learn about a topic or subject by working in groups to help students develop the ability to solve real world problems (Hung, 2016).

*Social Justice*: thoughtful critique of discrimination, bias, equity and oppression within the context of education that seeks inclusion, fairness and justice (Adams, Blumenfeld, Castañeda, Hackman, Peters, & Zúñiga, 2013).

*Student Attitude***:** attitude, perception and motivation about learning (Ernst & Monroe, 2004).

*Student Achievement***:** the amount of academic content a student leans in a determined amount of time, or a subset of skills and understanding at one specific point in time (Ernst & Monroe, 2004).

## CHAPTER TWO

## REVIEW OF LITERATURE

The local environment is a powerful context, method, and approach for teaching elementary students about science (Smith, 2002b). Exploring the natural world provides students with opportunities to become excited and enthusiastic about the place in which they live. Place-based education is a compelling instructional approach to integrate academic subjects, foster interest and motivation about science-based learning, provide opportunities for authentic, meaningful learning to increase academic achievement, and promote environmentally literate citizens (Stern, Powell, & Hill, 2014; Dieser & Bogner, 2016; Slade, Lowery. & Bland, 2013; Carrier-Martin, 2003). Sobel (2013) claims "authentic environmental and social commitment emerges out of firsthand experiences with real places on a small, manageable scale over time" (p. 13).

The purpose of this research was to evaluate the efficacy of *From Seeds to Shoreline*® resulting in measurable academic achievement and engagement in student participants when learning about ecology in an environmental setting. This review of literature places in context a study of teaching the *From Seeds to Shoreline*® educational program as means to improve student attitude toward learning science and student achievement on science tests. The research questions addressed in the research study were:

1. What impact does the *From Seeds to Shoreline*® program have on student engagement in learning science?

2. What impact does the *From Seeds to Shoreline®* program have on student achievement on science tests?

This chapter was organized into five sections that provide background and context for the action research study. After introducing the literary review, the historical perspective and context of place-based education was examined. The second section focused on the theoretical framework of place-based environmental education, emphasizing five important characteristics, or learning models. The literature reviewed includes studies which focus on the impact of place-based education on student attitude and engagement as well as the impact of place-based education on student science achievement scores. Finally, issues of social justice and place-based education were examined.

**Historical Perspective and Context**

Place-based education has a long history. It is based on well-established historical traditions of learning within specific locations (Sobel, 2013). Place-based education is described as "less of a new discipline than a recovery of the connections from which disciplines originally emerged" (Elder, 1998, p. 5). Elder (1998), a Woodbury College professor and researcher, originated the term *place-based education* while working with the Orion Society, a Massachusetts-based environmental organization, in the 1990s. Place-based education originated in environmental education with an emphasis on the sciences, conservation, and sustainable development (Elder, 1998).

Orr (1992) advanced the experiential component of place-based education. He explained that place-based education "requires the combination of intellect with experience…through "direct observation, investigation, experimentation, and skill in the application of knowledge (p. 128). Smith (2002) built upon the environmental and experiential aspects of place-based education and emphasized the nature of student-centered learning. Smith (2002) stressed “place-based education takes advantage of students’ natural interest in the world and their desire to be valued by others (p. 30).

Woodhouse and Knapp (2000) determined “progressive educators have promoted the concept of place-based education for more than 100 years” (p. 1). Place-based education is a direct result of interest in the nature studies movement (Sobel, 2013). According to research conducted by Ford (1986), beginning in the 1970s, support for outdoor, environmental education began to develop in schools across the United States. At that time, natural sciences were emphasized in environmental education. Interdisciplinary conservation and environmental programs such as Project Wild, Project Water Education (WET), and Project Learning Tree developed curriculum materials for elementary students as a result of the National Environmental Education Act enacted in 1970. These programs raised awareness of environmental education in schools (Ford, 1986). Additionally, in the 1960s and 1970s, a national movement investigating, exploring, and documenting rural Appalachian culture evolved into the Foxfire project (Smith, 2002b). Following the success of the Foxfire project, The Annenberg Rural Challenge set a goal to revitalize rural education in the late 1990s. After researching schools that participated in the Annenberg Rural Challenge, Theobald (1997) emphasized the revitalization of rural communities required a willingness to connect students to their own place. Place-based, environmental education teaches not only the natural environment, but also built environments. Sobel (2013) explained that place-based education is extensive and inclusive as “it examines how landscape, community infrastructure, and cultural traditions interact and shape each other" (p. 17). Students examine history, economics, culture, social problems, and the environment related to their community (Sobel, 2013).

## Theoretical Framework

Place-based, environmental education combines several learning models because it does not have a specific theoretical, pedagogical tradition. Gruenewald (2003a) describes place-based education theory as "comprising of practicing and purposes from experiential learning, contextual learning, problem-based learning, constructivism, outdoor education, indigenous education, environmental and ecological education, democratic, multicultural, community-based education, critical pedagogy, as well as other approaches that are concerned with context and the value of learning from and nurturing specific places, communities, or regions" (p. 3). This dissertation concentrated on five learning models, or approaches, to place-based education. The five defining characteristics of place-based environmental education provided the framework for student learning.

First, interdisciplinary learning connects the local environment to the curriculum content. Traditional lines between basic subject areas become vague as students learn reading, math, science, social studies and the arts (Hung, 2016) while investigating issues within their local ecosystem (Smith, 2002b). Additionally, problem-based learning experiences encourage students to become actively engaged in their own process of learning by solving problems and investigating issues of concern (Ernst & Monroe, 2004). According to Ernst and Monroe (2004), students determine the work becomes meaningful and worthwhile. The primary focus of learning experiences is based on student questions and concerns; therefore, it is student-centered instruction. Additionally, learning is grounded in the local place and the students' lived experiences in that place (Sobel, 2013). The final characteristic is a constructivist approach to learning. New learning is constructed from previous learning experiences on which skills and knowledge are built (Dewey, 1938). Ernst and Monroe (2004) included reflection as an essential part of each learning experience which further increases learning. Interdisciplinary learning, problem-based learning, student-centered instruction and constructivist approaches combine to provide a solid pedagogical and theoretical framework for the *From Seeds to Shoreline®* curriculum.

**Interdisciplinary Learning**

Place-based environmental education connects all disciplines to encourage deeper thinking and problem solving. The interdisciplinary approach encourages the curriculum to align with problems found in the real world. Traditional subject area and content skills are still taught; however, the approach is integrated. Savage and Drake (2016) claimed there are three levels of integration. Place-based education often incorporates comprehensive measures to address increasingly complex problems. There is a real-life context within the transdisciplinary approach, which is the highest level in curriculum integration (Savage & Drake, 2016). Transdisciplinary teaching and learning evolved as a response to the complexities of 21st century social, economic, and technological issues (Weismann, Biber-Klem, Grossenbacher-Mansuy, Hadorm, Huffman-Riem, Joye, & Zemp, 2008). Transdisciplinary curriculum is located at the far end of the integrated curriculum spectrum because it utilizes increasing degrees of integration. The transdisciplinary approach "transcends disciplinary boundaries" (Drake, 2012). By integrating perspectives of multiple disciplines, students connect new knowledge and deeper understanding to real-life experiences (Savage & Drake, 2016). Problem-based and place-based learning are characterized by a transdisciplinary approach to learning.

**Problem-based Learning**

Problem-based learning is a method of instruction and learning that utilizes student problem-solving to facilitate student learning (Mergendoller, Maxwell, & Bellisimo, 2006). Students learn through active engagement in the problem-based learning approach (Stentoft, 2017). In studies examining student attitudes toward learning, problem-based learning contributed to greater engagement in learning (Chu, Tse, & Chow, 2011). Additionally, the goal of problem-based learning is for students to make connections and extend concept knowledge to topics beyond the original problem (Stentoft, 2017). A study of elementary students participating in environmental lessons on sea animals found problem-based learning to be an effective means of teaching science content (Kaldi, Fillipatou & Govaris, 2011).

**Place and Location**

Ford (1985) explained place-based, outdoor education is “a method or process for extending the curriculum, or a process involving direct learning experiences in nature” (p. 3). Furthermore, Priest (1986) articulated that place-based, outdoor education is an experiential process of “learning by doing” (p. 14), which places learning outdoors. Experiential learning requires the use of learners’ senses. Lewis (1975) recognized the importance of sensory awareness when he stated, “Outdoor learning appeals to the use of the senses – audio, visual, taste, touch and smell – for observation and perception”

(Lewis, 1975, p. 9). Priest (1986) stated, “Learning in outdoor education takes place outdoors. While some aspects of learning may occur inside the classroom, such as a nature video, vocabulary lesson, and material preparation, nature provides the primary setting and inspiration for learning” (Priest, 1986, p. 14). Outdoor education embraces relationships between students and natural resources in the learning process (Priest, 1986). Priest (1986) further elaborated that outdoor education blends activities and experiences where students learn about their relationship with the natural environment, other students, and themselves (Priest, 1986, p. 15). Nichols (1982) emphasized six major characteristics of outdoor education: outdoor education occurs outdoors; students are directly involved in an activity; it involves the “interpretation of original objects”; it identifies and describes relationships rather than relying on individual, isolated facts; it involves all of the senses; engages students because the activity is “interesting, challenging or even fun” (Nichols, 1982, p. 1).

Outdoor education is typically categorized as experiential education (Ford, 1985). It encompasses meaningful learning experiences in the educational process. Outdoor education includes many subjects and touches on numerous learning styles. Any outdoor location, such as the school yard or salt marsh, provides direct contact with nature and authentic experiences which leads to quantitative and qualitative (Ford, 1985).

Many teachers experiment with outdoor education by providing instruction on the school grounds (Lloyd, Truong, & Gray, 2018). Outdoor education at school is easily accessible and provides efficient and frequent exposure that Carrier-Martin (2003) found beneficial. Carrier-Martin (2003) explained, “continuous, repeated activities with recognizable natural surroundings can have a stronger effect on student learning than occasional experiences in novel natural areas" (p. 52). Broda (2007) suggested outdoor instruction takes place anywhere on the school grounds which can provide a site for "academic learning, reflection, community involvement, and recreation" (p. 13). Any location on school grounds has the potential to be an effective place to teach any subject – especially science (Williams & Dixon, 2013).

**Student-Centered Instruction**

According to research by Rios and Brewer (2014) many educators agreed that the most effective method to learn science is using inquiry-based exploratory learning activities. Students increase their understanding of scientific content by actively questioning and engaging in science work (Rios & Brewer, 2014). Inquiry-based learning empowers students to think critically as they participate in the scientific process and make learning personally relevant (Rios & Brewer, 2014). Engagement with the natural world encourages students to reflect on the scientific process as they ask questions, predict, test, collect data, draw conclusions, and share findings Rios & Brewer, 2014). Duckworth (1996) suggested that teachers focus on ways

> "to catch [student] interest, to let them raise and answer their own questions, to let them realize their own ideas are significant – so that they have the interest, the ability, and the self-confidence to go on by themselves" (p. 52).

**Constructivist Theory**

The theoretical foundation of place-based education is directly attributed to Dewey's emphasis on connecting students to environment (Theobald, 1997). Constructivist Theory includes active learning whereby students learn from and build upon direct experience to form an understanding of the world. Dewey (1938) linked all education to experience as a natural learning method. Smith (2013), Powers (2004), and Woodhouse and Knapp (2000) made direct connections from Dewey to place-based education. Moreover, Powers (2005) linked the foundation of place-based education to Piaget's emphasis on intrinsic motivation and engagement and active learning. There is a natural fit as students construct their own learning surrounding their experiences (Piaget, 1954). Learning scientific content while studying the saltmarsh ecosystem allows students to actively construct knowledge based on relevant experiences using problem-solving through interdisciplinary inquiry (Bell, Binz, & Morganello, 2016). Students compare new knowledge to what they already know by asking questions, exploring, predicting, making connections, and assessing new understanding and knowledge. By providing place-based, environmental, outdoor instruction, such as *From Seeds to Shoreline®*, teachers inherently use constructivist practices (Dieser & Bogner, 2016). Using *From Seeds to Shoreline®* curriculum, students gathered and examined authentic data using authentic scientific instruments (Bell, Binz, & Morganello, 2016; Dieser & Bogner, 2016). Piaget (1954) stated that instruction based on cognitive constructivism supports student learning and children gain knowledge when they are active participants in their own learning. The literature reviewed supports the researchers claim *From Seeds to Shoreline®* is based on the constructivist model of learning which may help students connect and retain new scientific concepts (Cakir, 2008).

Within the constructivist framework based on Dewey's progressive theories, experiential education emphasizes the role experience plays in the learning process (Kolb, 1984). Experiential learning theory is "a holistic integrative perspective on learning that combines experience, perception, cognition and behavior" (Kolb, 1984, p.

21) which define the nature of experiential learning. According to Kolb (1984), “learning is the process whereby knowledge is created through the transformation of experience” (p. 38). Experiential learning suggests knowledge and skills are developed from direct experience. Learners construct new ideas and concepts built on an existing framework of previous knowledge (Kolb, 1984.) Sharp (1943) further advocated the experiential process “that which can best be learned through experience dealing directly with native materials and life situations outside the school should there be learned” (Sharp, 1943, p. 363). Students utilize more of their senses in the experiential process of learning. Mand (1967) stated “outdoor education involves a full sensory rather than an abstract approach to the subject matter. Children use their eyes, ears, nose, and muscles in the outdoors and learn through the process” (Mand, 1967, p. vi). Students participating in the *From Seeds to Shoreline®* program used their senses in an experiential process as they learned about the importance of the salt marsh ecosystem and actively contributed to all steps in the restoration process: seed collecting, germinating, cultivating, and planting *Spartina alterniflora* on coastal shorelines.

**Critical Theory.** Gruenewald (2003b) linked place-based education to Freire’s critical theory which focuses on empowerment of marginalized peoples and social justice. Because place-based education has historically maintained a commitment to environmental conservation and sustainable development, it is geared toward social action. Gruenewald (2003b) argued that place-based education and critical pedagogy are “mutually supportive” educational traditions. Gruenewald (2003b) stated, “place…foregrounds a narrative of local and regional politics that is attuned to the particularities of where people actually live, and that is connected to global development trends that impact local places" (Gruenewald, 2003b, p. 6). Gruenewald argued that status and power are tied to place. Subsequently, place influences social, political, economic and cultural systems. (Gruenewald, 2003b). As a result, Gruenewald (2003b) challenged educators to use the approach of place-based education to reduce social, political, economic, and cultural inequality. Specifically, Gruenewald (2003b) addressed two issues in developing the critical theory of place. The concepts of *decolonization* and *reinhabitation* were examined. First, Gruenewald suggested educators lead students to examine decolonization, or how people and land could be oppressed by dominant institutions which leads to privilege among the elites. Secondly, Gruenewald (2003b) stated that students must be allowed the opportunity to restore environmental, ecological, and social systems through reinhabitation. "In short, it [Place-based education pedagogy] means making a place for the cultural, political, economic and ecological dynamics of places whenever we talk about the purpose and practice of learning" (Gruenewald, 2003b, p. 11). According to Smith (2013), Gruenewald's critical theory of place links the efforts of place-based, environmental education with social justice concerns.

Stevenson (2007) elaborated on conflicts between the political nature of environmental education and traditional, mainstream education goals. Traditional education is not compatible with curriculum integration (Stevenson, 2007). Instead, traditional education promotes subject isolation and departmentalization. Stevenson (2007) argued that without the adoption of fully implemented place-based education initiatives which focus on social justice issues, "there is little chance that forms of care essential to environmental and social stewardship will emerge" (p. 192).

Moreover, place-based education recognizes that culture is a central tenant of learning (Ladson-Billings, 1994). Ladson-Billings emphasized that Culturally Responsive Teaching is a pedagogy that recognizes student cultural references in all aspects of student learning. Culturally Responsive pedagogy provides equal education access to all students (Howard, 2012) as it acknowledges and responds to unique communication, thinking and learning processes of all students (Ladson-Billings, 1994). Students from the low country are completely connected with their cultural surroundings as they study elements of the salt marsh.

The *From Seeds to Shoreline®* program connected students with nature utilizing the five approaches of place-based environmental education, Critical Theory, and Culturally Responsive Pedagogy. *From Seeds to Shoreline®* is comprised of five educational approaches that may encourage students to connect to their local environment, become more deeply engaged in learning, and perform at a higher level on achievement tests. By immersing learners in transdisciplinary, student centered, problem-based learning, within the context of local environment, and constructivist and experiential learning, *From Seeds to Shoreline®* is a place-based educational model that could be duplicated in schools in coastal areas with saltmarsh ecosystems and is worthy of scrutiny.

## Impact on Student Engagement

This section of the literature review is a study of placed-based education as a possible strategy to increase student interest in learning and an increase in science achievement. The Place-based Education Evaluation Collaborative (PEEC, 2010) is a group of five programs and one foundation which partnered to support place-based program implementation and evaluation. PEEC has conducted individual and cross-program evaluations of place-based education programs representing hundreds of schools in twelve states. Educators at schools using place-based education models consistently reported students increasingly engaged and enthusiastic about learning (PEEC, 2010).

Place-based education programs develop student environmental awareness, increased sensitivity and deeper understanding of students' relationship to the natural environment through knowledge of science concepts and personal experience. A study by Carrier-Martin (2003) indicated place-based, outdoor learning experiences develop positive environmental attitudes in students that can positively affect science engagement and achievement.

The most notable study of place-based educational approaches on student engagement and achievement was conducted by Lieberman and Hoody (1998). This study is recognized for its thoroughness and connection to place-based education. The State Education and Environment Roundtable (SEER) set a goal to improve student learning by integrating the environment in to K-12 curricula. "Environment as an Integrating Context (EIC) instructional methods utilize the environment as a focus for learning science, collaboration, and problem-solving skills" (Lieberman & Hoody, 1998, p.7). In the study, 98% of educators surveyed reported EIC increased student engagement and enthusiasm. Lieberman and Hoody (1998) assessed various instructional approaches by examining student behaviors and performance on standardized tests in 40 schools across the nation. The study found that EIC in school curricula improved student achievement in all content areas: science, social studies, language arts, and math. Students and educators reported significant effects in development of problem solving;

critical thinking and decision-making skills; increased enthusiasm and engagement in learning; and gains in summative measures of educational achievement such as standardized test scores and grade point average (Lieberman & Hoody, 1998).

One way to quantify the increase in enthusiasm and engagement was to survey students. By providing hands-on activities through problem-solving and project-based methods, student engagement and enthusiasm for learning science increased and students responded that they became “self-motivated learners” (Lieberman & Hoody, 1998, p. 9). Lieberman and Hoody (1998) provided evidence that students learn more effectively within an environment-based context than within the current traditional educational format. They study also offered multiple examples of EIC impact on reducing behavior-related incidents, which adds emphasis to the positive effects on student engagement (Lieberman & Hoody, 1998).

Skinner and Chi (2012) studied the effects of place-based education in a school garden. They examined the impact of gardening on student attitude and engagement in a diverse, urban, low-income middle school. Skinner and Chi (2012) described the outdoor instruction as “integrated, hands-on, project-based, cooperative, experiential learning activities” (p. 19). Skinner and Chi (2012) determined outdoor learning was responsible for fostering engagement. Students took a pre and post-test assessment and rated their perceived level of engagement on a five-point scale. Skinner and Chi (2012) reported a pattern of “significant and positive correlations with engagement in science, school, and academic self-perception” (p.17).

The Connecting Schools to People and Place Program (CS2P) was designed with the goal of providing students with knowledge, skills, and attitudes to become stewards of their local forests and other natural areas. The study was conducted in 2003 at a New Hampshire school. Evidence indicated CS2P impacted student engagement in a positive way (Powers & Powers, 2005). Data from the report showed significant changes to student enthusiasm including, "anticipation of and greater engagement during natural science activities; increased personal initiative toward learning natural science; and more productive participation in literacy activities when they related to natural science" (Powers & Powers, 2005, p. 7). Research by Ernst & Monroe (2004) indicated students are motivated to learn when they feel their learning is authentic and meaningful. Place-based education provides students with a connection to learning about their local ecosystem.

These studies present strong evidence for using a place-based education approach to teach students about all subjects, and especially science. By incorporating place-based, environmental, outdoor science instruction in their lessons, teachers may help students better understand concepts about the natural world. While there is great attention on creating and advancing new science standards, there has not been a similar focus on implementing quality place-based instruction to assist students to meet those standards (Malone, 2016). Overall, research literature reviewed suggests that outdoor education benefits students in areas of motivation, attitude, and engagement. (Lieberman & Hoody, 1998; Carrier-Martin, 2003; Powers & Powers, 2005; PEEC, 2010; Skinner & Chi, 2012). These same studies indicated programs like *From Seeds to Shoreline®* in scope and mission showed a positive impact on student motivation and attitude toward learning science (Lieberman & Hoody, 1998; Carrier-Martin, 2003; Powers & Powers, 2005; PEEC, 2010; Skinner & Chi, 2012).

## Impact on Student Achievement

The second research question was: What impact the *From Seeds to Shoreline®* program has on student understanding of environmental science and achievement? The teacher-researcher reviewed studies which showed an increase in student science achievement after experiencing similar place-based instruction and learning experiences as *From Seeds to Shoreline®.*

Academic achievement is often noted as one positive outcome of place-based education programs (Duffin, Chawla, & Sobel, 2005). The previously referenced SEER study (1998) reviewed in 40 schools showed encouraging results. Lieberman and Hoody (1998) shared data which indicated, “better performance on standardized measures of academic achievement in reading, writing, math, science, and social studies; reduced discipline and classroom management problems; increased engagement and enthusiasm for learning; and, greater pride and ownership in accomplishments” (p. 22). The study concluded students learn more effectively within an EIC rather than a traditional educational context (Lieberman & Hoody, 1998). Evidence was gathered from over 400 student interviews, 250 teacher and administrator interviews, comparative studies of standardized test scores, Student Grade Point Averages, and measures of student attitude. Analysis of standardized test scores demonstrated a quantitative increase in achievement in all schools (Lieberman & Hoody, 1998).

In a 2004 study of the impact of environmental education on science achievement, Bartosh (2004) compared 77 pairs of demographically similar schools in Washington state which had implemented environmental education programs. State standardized test scores and Iowa Test of Basic Skills scores were compared. Students and teachers also completed surveys to evaluate the teaching and learning environments (Bartosh, 2004). Bartosh's (2004) findings indicated schools with systematic environmental education programs showed statistically significant higher test scores on standardized test in math, reading, writing, and listening. Bartosh (2004) observed the pattern of environmental education school students' higher test scores continued throughout the five years (1997-2002) from which data was collected.

Cronin-Jones, Klosterman, and Mesa (2006) specifically studied the effects of teaching science lessons outside. The study included elementary students in six classrooms at two schools. Cronin-Jones et al. (2006) determined that students who participated in the outdoor instruction retained more science knowledge that students whose instruction was offered indoors. The literature review highlighted studies which informed readers that outdoor education is beneficial to student science achievement. The studies indicated students learn more science content when environmental lessons were taught outdoors (Cronin-Jones, Klosterman, & Mesa, 2002). Similar studies confirmed these findings that outdoor educational activities and lessons helped students learn more about science topics than traditional indoor learning activities such as videos, reading passages, lectures, or discussions (Mannion, Fenwick, & Lynch, 2013; Rios & Brewer, 2014; Sobel, 2013).

Recent analyses of garden-based environmental education studies indicated school garden programs have positive effects on students' academic achievement (Blair, 2010; Williams & Dixon, 2013). "A preponderance of positive impacts on direct academic outcomes" (Williams & Dixon, 2013) was reported after analyzing 48 school garden studies. Blair (2010) reviewed literature on elementary garden programs.

Quantitative studies showed positive science outcomes related to school gardening initiatives, but did not conclude science attitude improved (Blair, 2010). Specifically, findings from a study of fifth grade students in Washington DC showed a positive correlation between school gardens and higher achievement in science, math and reading (Ray, Fisher, & Fisher-Maltese, 2016).

A study by Vasconcelos (2012) examined the effectiveness of outdoor learning related to the local environment. Elementary students conducted research and gathered data within a problem-based learning framework. This environmental education instruction allowed students to construct meaning as they authentically solved problems. Vasconcelos (2012) noted the importance of allowing students to reflect on a local problem about which data can be collected, which is similar to the *From Seeds to Shoreline®* program. The study described instructional activities teachers might consider using for outdoor education to impact student attitude and achievement in science (Vasconcelos, 2012).

Bringing Up Girls in Science (BUGS) was an afterschool program for fourth and fifth grade girls providing authentic learning experiences in environmental science. The 3-year project was funded by the National Science Foundation, and it was conducted in the mid- 1990s. The quasi-experimental study matched students with a comparison group with similar characteristics from another school district. Results indicated that the BUGS participants demonstrated significantly greater gains in science knowledge as measured by the Iowa Test of Basic Skills in Science (Tyler-Wood, Ellison, Lim, & Periathiruvadi, 2012).

Sugg (2015) conducted a case study of place-based education strategies at a school in Appalachia serving primarily low-income students. The school was recognized for state-leading test scores, even as the school dismissed test preparation, considered state standards as a baseline instead of a goal, and relied on formative assessment to evaluate student learning (Sugg, 2015).

## Social Justice

In his book, *Last Child in the Woods* (2008), Richard Louv alerted readers to a problem he calls "nature deficit disorder" as children grow increasingly disconnected from nature and their environment. Louv (2008) stressed "young people need the opportunity to connect with nature in order to learn and grow into healthy, responsible, and engaged community citizens" (p.22). Place-based education emphasizes environmental literacy and sustainability, and it provides the opportunity to connect with nature and develop the understandings needed to be healthy adults, active citizens, and environmental stewards (Louv, 2008). Integration of place-based education provides a way to link outdoor experiences and environmental learning with the science standards and benchmarks taught in the classroom (Louv, 2008). This approach also adds local relevance to help students connect to the places in which they live and learn.

The Nature Conservancy (2014) conducted a survey of students regarding their attitudes about nature, outdoor activities, and environmental issues. Data from the survey supported Louv's (2008) findings that children spend more time on indoor activities. Students reported feelings of discomfort, and lack of access, specifically transportation, as barriers to spending time exploring nature (The Nature Conservancy, 2014, p. 3).

McKenzie (2013) argued that outdoor experiential learning is an antidote to virtual and insular student lifestyles.

Moreover, a recent study of 9-11-year-old children in New Zealand indicated children are often restricted from accessing natural areas (Hand, Freeman, Seddon, Recio, Stein, & van Heezik, 2018). Researchers discovered parent and social restrictions prevented students for exploring nature, even when children have access to recreational areas, such as public parks and salt marshes. The study indicated children's engagement with nature occurred primarily in private yards and public parks. Therefore, private land is linked to socioeconomic status, which results in social inequalities in access of nature (Hand, et al, 2018).

The low country location in which this study was conducted is a similar setting (Keefner, 2015). Not all students have equal access to natural areas. Expanding on this theme of socioeconomic inequality in nature, minority and poor students are less likely to have access to and engage in learning experiences and activities which increase academic achievement (Fenichel & Schweingruber, 2010).

Some environmental programs examined were associated with camp programs (Bogner, 1998; Knox, Moynihan, & Markowitz, 2003; Larson, Castelberry, & Green, 2010; Erdogan, 2015). Economic and cultural barriers may limit access to and participation in place-based, experiential, outdoor learning opportunities to those without means (Fenichel & Schweingruber, 2010). *From Seeds to Shoreline*® learning experiences were conducted in the school yard and at a local salt marsh while on a school-sponsored field trip, so access and transportation did not impede student participation.

Recent scores on the Palmetto Assessment of State Standards (PASS) science test showed a decrease of 14.7 points between the years 2009 to 2014. Students identified as ELL students on a home survey received additional reading, writing and language support from certified teachers. Unfortunately, these students performed at a lower level than students whose primary or only language is English (Keefner, 2015). As a matter of social justice in providing a quality education to students who struggle with learning science, it is imperative that educators determine more effective ways to teach science to English Language Learners (ELL) students.

Cuevas, Lee, Hart, and Deakor (2006) examined the impact of inquiry-based instruction on narrowing the science content knowledge gaps for students from diverse backgrounds. Researchers noted the inquiry-based instructional intervention for third and fourth grade students significantly increased the content knowledge of students of lower socio-economic status and ELL students. However, the researchers indicated many students of concern continued to struggle with vocabulary (Cuevas, et al, 2006). Skinner and Chi (2012) studied the effects of outdoor, garden-based education on student engagement in a diverse and low-income middle school. The ELL population was comparable to the students involved in the *From Seeds to Shoreline®* study. After outdoor lessons in the school garden and pre and post-test assessments of student interest using a five-point rating scale, Skinner and Chi concluded, "students who were more engaged in the gardens were more likely to be engaged in science and in school in general" (Skinner & Chi, 2012, p. 29).

Another relevant study (Leonard, Chamberlin, Johnson, & Verma, 2016) which indicated equitable, place-based, outdoor science instruction increased minority students' attitude toward learning science and science achievement. This study was designed response to the social justice concern of minority students' underrepresentation in college and workforce STEM fields. According to Leonard, Chamberlin, Johnson, and Verma (2016), preparation for science careers begin in elementary school. Educators and scientists collaborated to provide outdoor science instruction. The study included student work samples, pre- and posttests, questionnaires, informal discussions, teacher observation, and interviews to examine student attitude toward learning science and changes in science achievement. Results of the study indicated positive student attitude toward learning science and measurable increase in content knowledge (Leonard, Chamberlin, Johnson, & Verma, 2016).

A study by Lee, Buxton, Lewis & LeRoy (2006) suggested students from lower socioeconomic backgrounds showed greater gains in inquiry-based learning experiences than their more privileged peers. This study of third and fourth grade students in six elementary schools indicated students from diverse backgrounds thrive within learning environments that foster scientific inquiry and authentic learning (Lee et al., 2006). Researchers concluded that place-based learning experiences were motivating and empowering for the students "and likely influenced their interest about science in ways that science classrooms and textbooks could not" (Leonard, Chamberlin, Johnson, & Verma, 2016, p. 375).

## Conclusion

The literature review aligned the history of place-based education with positive impact on student attitude and achievement (Lieberman & Hoody, 1998; Skinner & Chi, 2012; Williams & Dixon, 2018; PEEC, 2010; Leonard et al., 2016) The research literature presented indicated placed-based, environmental, outdoor instruction, either alone, or combined with traditional classroom instruction, was effective in increasing both student attitude toward learning science and increasing student achievement on science tests. There is great potential to increase student engagement and understanding of the natural world. Based on place-based education literature reviewed, the teacher-researcher hypothesized the *From Seeds to Shoreline®* place-based, environmental program would positively impact student attitude and achievement in science.

# CHAPTER THREE

# METHODOLOGY

Place-based educational practices were customary in American education in the early twentieth century before the standardization of education began to disrupt local approaches to learning (Lewicki, 2010). A thorough reading of place-based education literature led to the recognition that the use of place-based, outdoor, experiential instruction in the schoolyard or other natural settings can be an effective setting for meaningful science instruction. The work of Gruenewald (2003a; 2003b), Sobel (2013), Theobald (1997), and Smith (2002a) provided the initial framework of place-based education.

The research methodology of this study was informed by positive student outcomes in increased student engagement and achievement in the previous review of the literature (Skinner & Chi, 2012; Lieberman & Hoody, 1998; PEEC, 2010; Carrier-Martin, 2003; Powers & Powers, 2005; Williams & Dixon, 2013; Ray et al, 2016). Therefore, this action research study focused on investigating the impact of the *From Seeds to Shoreline*® program on student motivation, engagement, and science content knowledge. This chapter described the methodology employed during the mixed-method study on outdoor, experiential science instruction.

## Purpose of the Study

The purpose of this action research study was to determine the effectiveness of the *From Seeds to Shoreline*® program on impacting student engagement and student achievement in science education. The mission of the *From Seeds to Shoreline®* program was to encourage students to learn about the importance of their local, critical, coastal ecosystem, and restore areas of the saltmarsh (Bell, Binz, & Morganello, 2016). The curriculum is aligned with and supports Next Generation Science Standards (NGSS) and South Carolina State Science Standards. *From Seeds to Shoreline®* immersed fourth grade students in natural science education with experiential learning, team activities, outdoor field lessons, and a field trip to a nearby salt marsh. Most of the *From Seeds to Shoreline®* lessons and activities were conducted on the school grounds, including the outdoor lab and garden. Therefore, all students in the teacher-researcher class participated in the outdoor science experiences during the regular school day.

The objective of the study was to increase student participants' attitude and enthusiasm toward science instruction and increase their knowledge of natural science, leading to increased achievement on standardized benchmark testing. The primary purpose of this action research study was to determine if implementing *From Seeds to Shoreline®*, a place-based, outdoor, experiential learning curriculum, which incorporated interdisciplinary learning, problem-based learning, and student inquiry, would lead to increases in student attitude and achievement.

## Research Questions

To examine the effects of the Seeds to Shoreline® curriculum on students' understanding and appreciation of science concepts, the following research questions were asked:

- What impact does the *From Seeds to Shoreline®* program have on student attitude and engagement in learning science concepts?

- What impact does the *From Seeds to Shoreline®* curriculum, an inquiry-based instructional program utilizing problem-solving, cooperative learning have on fourth grade students' science achievement?

## Overview of the Chapter

Chapter Three of the dissertation examined the action research process, and subsequently provided a thorough description of the research design with a detailed rationale for the selected methodology. The teacher-researcher described the context and setting of the study, identified the role of the researcher, and described the participants and their individual learning characteristics. Finally, the teacher-researcher outlined the research plan and specific procedures which informed how the data was collected and analyzed in Chapter Four.

## Research Design

An action research model informed the instructional and learning design process of this mixed-methods research study. Action research is a process in which educators systematically examine their own practice using critical and rigorous research techniques (Mertler, 2014). It is comprised of recurring cycles of planning, acting, observing, refining, and reflecting (Mertler, 2014). Action research assumes that practitioners work best on problems they have identified for themselves. Practitioners are more effective when encouraged to examine and assess their work, followed by a consideration of ways to working differently (Watts, 1985). Action research provided a link between theory and practice as it is teacher-initiated and classroom-based. In the context of elementary science education, action research is utilized to develop and implement a research plan, analyze student data, observe student engagement, reflect, and refine instruction.

Combining the action research seven-step cycle as outlined by Mertler (2014) with a review of relevant and related literature provided a thorough examination of best practices for elementary science instruction. Additionally, the process of reflection encouraged innovation and deeper exploration regarding student learning (Mertler, 2014).

To determine the effectiveness of the *From Seeds to Shoreline®* program in fostering improved scientific attitudes, concepts and skills among student participants, the researcher gathered both quantitative and qualitative data throughout the study. A mixed methods design captured the effect of the place-based education intervention on students' motivation and achievement. A variety of methods highlighted the relationship between the quantitative and qualitative constructs of research. Quantitative data collected included a pre and post content knowledge test, and general science knowledge assessment. Qualitative data collected included a pre and post survey utilizing Likert scales to assess students' perceptions of science motivation and engagement and student interviews.

**Rationale for Selected Methodology**

A mixed methods design for this action research study was appropriate because qualitative and quantitative data enabled the teacher-researcher to better understand student interest in science-based learning and academic achievement. Because student perspective is a powerful component of place-based learning, student interviews were especially useful in recognizing student enthusiasm and degree of understanding. Quantitative data provided a method to measure changes in achievement. The mixed method component of the research study allowed the researcher to investigate the relationship between the qualitative and quantitative findings (Patton, 2002). Combining numerical and narrative data on each student's learning process allowed the researcher to thoroughly examine the effect of the *From Seeds to Shoreline®* program in fostering improved scientific attitudes, concepts and skills among student participants.

**Context and Setting of Study**

The site for this action research was an elementary school located in the South Carolina low country. Instruction and learning experiences took place on the school grounds, in the school garden, and at a local nature center along the salt marsh. Students received content knowledge instruction in all locations with additional limited instruction in the classroom. The target group for this action research study was fourth grade student participants. The suburban school had a population of nearly 800 diverse students in grades 1-5. The student body was made up of 46% boys and 56% girls. The racial makeup of the school was: 14% African-American, 40% Hispanic, 42% White, 4% Asian/Two or more races or ethnicities. Of the current school population 36% was identified as Limited English Proficiency (LEP). Nearly 65% of students met the criteria for the poverty index (Medicaid, SNAP, TANF, homeless, foster, or migrant status). Over 14% of the students were identified and served as Gifted and Talented. Approximately 10% of students had identified and recognized disabilities which impede their learning (Keefner, 2015).

The school district serves a dichotomous community. Many people in the town are very wealthy with strong financial stability, a high rate of traditional family structure with two parents who are well educated, and incredible enrichment opportunities. The other segment of the school population has specific educational challenges. Over 20% of the students live with single parents or guardians. Many students' caregivers have multiple, low-wage jobs, high illiteracy rates, lower academic achievement, and speak languages other than English. The percentage of students meeting the criteria for the State Poverty Index increased from 51% in 2007 to 65% in 2015. Nearly 300 students are self-identified as second language learners from sixteen countries, most with non or limited English speaking parents. Enrollment data from the past two years indicated 80% of new students are ethnic minorities. The school reported that among minority parents, there was an estimated 70% illiteracy rate (Keefner, 2015).

The study was conducted during the last six weeks of the Spring semester. Over the course of the study, the researcher collected both quantitative and qualitative data during lessons and learning activities in the classroom, in the school garden, around the school yard, at the local nature center, and in the salt marsh. The researcher concurrently gathered data compiled from formative and summative content assessments along student perception of learning gleaned from student interviews.

**Role of the Researcher**

Action research is an effective way of improving teaching, student assessment, student understanding, and determining the most effective strategies for student learning. (Sagor, 2000). By comparing student learning outcomes of different teaching strategies, the goal of the teacher-researcher was to discover the effect of the *From Seeds to Shoreline*® program on student engagement and achievement. Findings had immediate practical significance concerning teaching decisions.

Classroom action research followed the same steps as the general scientific model. The primary role of the researcher was classroom teacher, and the research could not take precedence over student learning. (Sagor, 2000). The teacher-researcher conducted a seven-step classroom research process: identify problem or question, review literature, plan a research strategy, gather data, analyze data, act, and share findings with colleagues and others within the educational community (Mills, 2007; Mertler, 2004; Sagor, 2000).

Following that model, the teacher-researcher developed the research questions related to the impact of *From Seeds to Shoreline®* on student engagement and achievement in science. A review of the literature indicated experiential learning has mostly positive impacts on student engagement and achievement (PEEC, 2010; Lieberman & Hoody, 1998; Skinner & Chi, 2012; Powers & Powers, 2005; Cronin-Jones, 2002; Williams & Dixon, 2013). Regarding this action research study, the teacher-researcher was specifically interested in the impact of the *From Seeds to Shoreline®* program on student engagement and achievement.

**Student Participants**

The target group for the action research study were volunteer student participants assigned by administration to the teacher-researcher's class. Twenty, fourth-grade students were invited to participate in the study. Parental consent was received for all twenty students, which was 100% return rate. Students were 45% female and 55% male. Students were ethnically and racially diverse. The class consisted of majority Latino/Hispanic students with 7 Latino/Hispanic males and 5 Latino/Hispanic females. Students were also linguistically diverse as English was not the primary language spoken at home for 45% of students. This indicated the high number of immigrant families in the community. The most common language spoken at home was Spanish. Therefore, parental consent materials were translated into Spanish.

The twenty student-participants are described using pseudonyms as follows:

- Justin is a 10-year-old Latino male. He is an intelligent, conscientious, high-achieving student who uses humor to easily make friends. He receives ESOL services as English is his second language, and he primarily speaks Spanish at home with his mother and two siblings. He qualifies for free and reduced lunch.
- Louisa is a ten-year-old Latina female. She is a skilled athlete and her father coaches her on an elite soccer team. She participates in the school chorus. She is a bright student who makes good grades and aspires to attend college like her older brother. She receives ESOL service as English is her second language. She speaks mostly Spanish in the home with her bilingual family. She qualifies for free and reduced lunch.
- Kevin is a ten-year-old while male. He qualified for Gifted and Talented services; however, his family decided to remove him from the GT reading, social studies and science class because he found the pace of the work a source of stress and anxiety. Kevin enjoys sports, participates in numerous enrichment activities, and he is well-traveled.
- Mark is a nine-year-old Latino male. He receives ESOL service as English is his second language and his family speaks only Spanish at home. Mark appears quiet and appears to struggle with focusing on classwork. He has difficulty understanding class assignments due to his lack of focus and his limited English proficiency. His grades are considerably lower than most of his peers in class. He qualifies for free and reduced lunch.

- Jason is a ten-year-old Latino male. He is a conscientious student. He completes all assignments and puts forth strong effort. He appears reserved and quiet; however, he is popular amongst his peers. He enjoys playing soccer at recess. His father reviews math lessons with him every night. He receives ESOL service as English is his second language, and he speaks only Spanish at home with his family.
- Callie is a nine-year-old Latina female. She is talkative and social. Her mother works in education and is in frequent contact regarding her behavior. She is a bright student and her strong English language skills enabled her to test out of ESOL service. Her family speaks only Spanish at home.
- Michael is a ten-year-old Latino male. He is very friendly, talkative, and avoids schoolwork when possible. He qualifies for ESOL and speech services. His mother and siblings speak Spanish at home. He qualifies for free and reduced lunch.
- Fredrick is a ten-year-old Latino male. He qualified for Gifted and Talented service, but administration decided to remove him from that setting due to low academic performance. Frederick is generally quiet and a hard worker. He is eager to learn and contributes often to class discussions. He recently tested out of ESOL service, but he continues to speak Spanish at home with his mother and siblings. He qualifies for free and reduced lunch.
- Laura is a ten-year-old white female. She is a conscientious, motivated, and high-achieving student. She participates in many school activities: chorus, drama, science club and sports.

- Derrick is a ten-year-old black male. He struggles to learn fourth grade material as he learns at a slower pace. He reads at a level significantly below his peers. He is generally friendly and well-liked; however, he occasionally exerts problematic behaviors. He lives most of the time with his grandfather and some of the time with his mother. He qualifies for free and reduced lunch.
- Carmen is a ten-year-old black female. She was originally served in the Gifted and Talented class. Her mother decided to withdraw her from the GT class because she found the pace of the work a source of stress and anxiety. She plays basketball and admires her older sister in college. She receives free and reduced lunch.
- Summer is a nine-year-old white female. She is creative and artistic, and she appreciates school dance class and chorus.
- Henry is a ten-year-old multiple ethnicity male. He qualified for GT math service. He struggles with reading vocabulary and comprehension. He is talkative and impulsive. He qualifies for free and reduced lunch.
- Patrick is a ten-year-old Latino male. He does not qualify for ESOL service as his family speaks only English at home. He is a conscientious, high-achieving student. His parents are in frequent contact to monitor his work and behavior.
- Alicia is a ten-year-old Latina female. She is a hard-working, yet lower-achieving student. She struggles with fourth grade math concepts and reading comprehension. She receives ESOL services as English is her second language, and she primarily speaks Spanish at home with her mother and two siblings. She qualifies for free and reduced lunch.

- Amy is a nine-year-old Latina female. She is a hard-working student. She receives ESOL services as English is her second language, and she primarily speaks Spanish at home with her family. As a result of her low end of grade math achievement, she also receives math tutoring. She qualifies for free and reduced lunch.
- Eddie is a nine-year-old Latino male. He has many absences because of health issues. He receives ESOL services as English is his second language, and he primarily speaks Spanish at home with his family. He qualifies for free and reduced lunch.
- Stella is a ten-year-old white female. She shows signs of dyslexia which impede her learning. She is a conscientious student who puts forth good effort. She participates in school chorus and dance.
- Rose is a ten-year-old multiple ethnicity female. She was originally served in the Gifted and Talented class. Her mother decided to withdraw her from the GT class because she found the pace of the work a source of stress and anxiety. She lacks confidence which prevents her from putting forth her best effort.
- Dakota is a ten-year-old white male. His standardized test scores indicate he should qualify for Gifted and Talented service. He lacks focus and cannot complete a timed test in the allotted time in order to qualify for GT service. He is very bright; yet he does not complete many assignments. He reads at a high level.

**Ethical Concerns**

The entire class of fourth grade students participated in the study as the strategy of teaching *From Seeds to Shoreline®* curriculum did not pose risk to any students. The teacher-researcher was an active participant observer in the research study. Informed consent was obtained from 100% of the students' parents or guardians. To ensure individual privacy, anonymity and confidentiality of participants, pseudonyms were assigned to each student. All research materials were secured throughout all steps of the research process. Research intentions, methods and results were shared with students, parents and administrators. Additionally, permission from the school district to conduct research was obtained. Personal bias was an important ethical consideration. It was important for the teacher-researcher to analyze and report all data, not simply data reflecting a positive impact on student engagement and achievement while participating in the *From Seeds to Shoreline®* program. It was also the responsibility of the teacher-researcher to reduce potential bias resulting from the researcher conducting both the evaluation and the intervention (Bogner, 1998).

**Planning Stage**

With the research questions in mind, the teacher-researcher utilized all seven stages of the action research process. To determine the impact of the *From Seeds to Shoreline®* program on student attitude, engagement and achievement regarding science instruction, the teacher-researcher fully participated in the seven stages of action research, beginning with the planning stage.

The planning stage consisted of identifying and limiting the topic of study; gathering information and reviewing related literature; and developing a research plan (Mertler, 2014). To identify and limit the topic of study, the teacher-researcher attended a *From Seeds to Shoreline®* workshop training during the summer. The training included model lessons taught by members of Clemson University Cooperative Extension staff and the South Carolina Department of Natural Resources educational staff. Participants learned the salt marsh is a critical habitat that provides environmental and economic benefits to coastal and inland communities. Because of the importance of the salt marsh ecosystem, several governmental, science, and education agencies collaborated to develop an educational program to engage students in salt marsh restoration. Teachers were invited to participate in the workshop and use the program in their classroom to educate students about the importance of protecting the salt marsh ecosystem.

The teacher-researcher recognized an opportunity to engage all students in meaningful and authentic learning experiences based on the ecosystem in which they live. The *From Seeds to Shoreline*® program encouraged instruction based on integrated components of constructivist experiential education. Lessons and learning experiences allowed for interdisciplinary learning in which the science content was connected to the local environment. Traditional lines between subject areas were blurred so that students could incorporate reading, math, social studies, and art with science as they learn outdoors and in the salt marsh. Learning experiences were problem-based. Students were actively engaged in the learning process, questioning and solving problems, investigating solutions, and creating meaningful products, such as the class garden.

Moreover, the teacher researcher recognized an opportunity to utilize culturally responsive pedagogy. The diversity of student experience, knowledge and skills made an impact on students' education and connect to their lives outside of school (Howard, 2014). Informed by principles of culturally responsive pedagogy, *From Seeds to Shoreline*® used the school garden, outdoor spaces, and the salt marsh as the context for authentic, experiential learning activities. Additionally, the *From Seeds to Shoreline*®

program drew upon the motivational framework of Self-Determination Theory (SDT) (Ryan & Deci, 2017) in providing learning experiences that meet students' psychological needs for competence, relatedness, and autonomy in their academic work. SDT is further examined in Chapter Four.

The teacher researcher began to collect and organize place-based, experiential, outdoor lessons taught within the framework of the Seeds to Shoreline® program and grounded in place-based, experiential, outdoor, constructivist pedagogy. Learning experiences, lessons, and testing were facilitated according to the schedule in Table 3.1.

Table 3.1 Lesson Schedule

| Week 1 | Outdoor Lessons | Data Collection Instruments |
|---|---|---|
| | Soil Comparison<br>Composting<br>Decomposers | Fall 2017 MAP pretest scores<br>USATestprep© pretest<br>Salt Marsh Art pretest<br>Science Motivation and Engagement presurvey |
| Week 2 | Beginning the Class Garden | Student journals |
| Week 3 | Creating Ecosystem Ecocolumns<br>Pollinators<br>Flowering and Non-flowering plants | Student journals |
| Week 4 | Inherited Traits and Learned Behaviors<br>Vertebrates and Invertebrates<br>Field Trip:<br>Butterfly Habitat | Student journals<br>Student interviews |
| Week 5 | Vertebrates of the Lowcountry<br>Plant and Animal Relationships | Student journals |
| Week 6 | Field Trip:<br>Squid Dissection<br>Salt Marsh Scavenger Hunt<br>Salt Marsh Trisection | MAP posttest<br>USATestprep© posttest<br>Salt Marsh Art posttest<br>Science Motivation and Engagement postsurvey<br>Student interviews |

**Learning Standards Addressed with *From Seeds to Shoreline®***

From Seeds to Shoreline® aligns with state standards within the K-12 educational spectrum (Bell, Binz, and Morganello, 2018). Because *From Seeds to Shoreline®* is an interdisciplinary approach to learning, multiple South Carolina fourth grade learning standards were addressed. Standards were organized on Table 3.2 to categorize the cross-curricular standards.

Table 3.2 Learning Standards

| Subject | Standards |
|---|---|
| Science | **4.L.5:** The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce. |
| Math | **4.MDA.2:** Solve real-world problems involving distance/length, intervals of time within 12 hours, liquid volume, mass, and money using the four operations<br>**4.MDA.3:** Apply the area and perimeter formulas for rectangles.<br>**4.ATO.2:** Solve real-world problems using multiplication (product unknown) and division (group size unknown, number of groups unknown). |
| ELA | **Standard 1**: Formulate relevant, self-generated questions based on interests and/or needs that can be investigated.<br>**Standard 2:** Transact with texts to formulate questions, propose explanations, and consider alternative views and multiple perspectives.<br>**Standard 3:** Construct knowledge, applying disciplinary concepts and tools, to build deeper understanding of the world through exploration, collaboration, and analysis.<br>**Standard 4:** Synthesize integrated information to share learning and/or take action. |
| Social Studies | Literacy Skills:<br>• Establish the chronological order in reconstructing a historical narrative.<br>• Identify and explain cause-and-effect relationships.<br>• Identify the locations of places, the conditions at places, and the connections between places.<br>• Create maps, mental maps, and geographic models to represent spatial relationships.<br>• Interpret visual information to deepen his or her understanding. |

## Data Collection Instrumentation and Methods

Data were collected from twenty, fourth-grade student participants in the researcher's class at a suburban elementary school in South Carolina. Data collection included the use of surveys, student journals, student interviews, and pre and post assessments. Data was collected during the last two months of school. The guiding research questions for the collection of data was, what impact does the *From Seeds to Shoreline*® curriculum have on student engagement, and what impact does the *From Seeds to Shoreline*® curriculum have on student achievement in science?

### Science Motivation and Engagement Survey

The researcher administered a survey (Appendix B) to the fourth-grade science class to determine their initial perception about their motivation to learn science concepts. The teacher-researcher created a survey instrument that elicited information tailored to *From Seeds to Shoreline®.* The survey was modeled from a survey developed by Skinner and Chi (2017) to assess relatedness, competence, purpose, and autonomy using a theoretical model of motivational engagement. The authors of the survey instrument recommended using the survey to assist researchers in investigating how student STEM identity, motivation, learning, and grades in science are used as a model of motivational development (Skinner & Chi, 2012). The teacher-researcher constructed survey was used to establish a baseline motivational score for each student-participant at the beginning of the study. A post-study score was used to evaluate changes in student attitudes and perceptions after *From Seeds to Shoreline*® lessons and learning activities.

### USATestprep© Science Pre and Post Tests

The teacher-researcher administered a pre-test of science content knowledge to student-participants the second day of the action research cycle. At the end of the data collection period, a post-test was administered to all student-participants. USATestprep© is an Integrated Learning System utilized by the school district to allow students to practice questions similar to questions found on end of grade standardized tests. The teacher-researcher selected test questions which addressed Next Generation Science Standards as well as South Carolina Academic Standards and Performance Indicators for Science (2014) specific to fourth grade students. The purpose of the standards-based content assessment was to examine the impact of the outdoor, experiential education learning experience on student academic achievement in terms of content mastery. The measure focused specifically on South Carolina science standard 4.L.5: *The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.*

### Science Measures of Academic Progress (MAP)

The Science MAP was administered in the fall to all participants. MAP dynamically adjusts to student responses on assessment to measure student mastery of content knowledge on each science strand. MAP data analysis informed the teacher-researcher as to what specific science standards should be addressed.

### Student Interviews

Interviews provided teacher-researchers information and insight on how, what, and to what degree students learned the science content. All twenty students participated in semi-structured student interviews throughout the data recording period. The teacher-researcher asked open-ended questions and prompted student reflection. Interviews were recorded. The interview process provided an opportunity to determine the level of student understanding, student progress, engagement in the learning activities, and questions or misconceptions about the material. Moreover, data from student interviews were included as a descriptive summary to further enhance the data collection report of this action research process. The teacher-researcher created codes using NVivo software. Consequently, coding categories were determined by key phrases and words students said during the interviews. The teacher researcher gleaned emerging themes from the students' own words.

## Procedure

The design of the study followed a mixed method design which encompassed both quantitative and qualitative methods. Student-participants in this action research study participated in outdoor science instruction every day from 1:30 – 2:25 pm. At the beginning of the six-week data collection period, student-participants completed the Science Motivation and Engagement Survey (Appendix B). The teacher-researcher read the survey aloud to all students. Survey results were used to identify areas of student self-reported areas of weakness and strength related to four primary areas of motivation: relatedness, competence, purpose, and autonomy (Skinner & Chi, 2012). Student participants then completed the USATestprep© pre-test to provide a baseline for science content knowledge before outdoor, experiential lessons were introduced.

Instruction for the science concepts consisted of questioning, inquiry and exploration of topics related to a specific standard in which student are expected to demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce. Learning activities occurred in several outdoor settings, including the school yard, school garden, the local nature center, and the salt marsh. During the data collection period, the teacher-researcher facilitated lessons in the school yard, garden, and the salt marsh. Three field experts taught students lessons at the nature center and in the school yard. Learning experiences were planned over a 5-1/2-week span to allow for pre and post testing.

## Data Analysis

A mixed method research design format highlights the relationship between quantitative and qualitative findings (Eisenhart, 2005). By incorporating a variety of data collection in this study, there was greater opportunity for triangulation, a strength in the mixed method design which allows consistency in the interpretation of data (Patton, 2002).

Quantitative methods in this study were used to determine the impact of place-based learning experiences on science knowledge. The purpose of the qualitative measures was to examine the impact of the place-based, outdoor learning experiences on student motivation and engagement in learning specific science concepts. After data collection was completed, the survey results were recorded on an Excel spreadsheet. Scales to assess competence, relatedness, and autonomy using Skinner and Chi's (2017) theoretical model of motivational engagement were included on the survey. Independent sample t-tests were used to detect statistically significant differences among tests. The criterion used for statistical significance was $p<.05$.

Descriptive statistics allowed the teacher-researcher to describe the data collected during the study. An independent measure t-test was used to determine if any statistical difference exists between the pretest and posttest student scores. The teacher-researcher did not anticipate generalizing the information to a larger population, so inferential statistics were not necessary. Central tendency was measured by comparing the mean of the pretest and posttest scores of the student participants. Data are displayed using a distribution table and a bar graph. A matched paired t-test of the pretest and posttest data was used to determine if the growth was significant. Student engagement and attitude toward learning were measured using the teacher-researcher created Science Motivation and Engagement Survey based on a survey developed by Skinner and Chi (2017). Data analysis was concentrated on a comparative analysis approach based on coding to form inductive, connected themes (Denzin, 2005). Descriptive coding, which is useful when examining multiple data sources, allowed the teacher-researcher to summarize broad topics within the research.

Qualitative data were collected through semi-structured interviews with each student. The recorded interviews were carefully reviewed and analyzed to recognize common themes discussed by student-participants in the study. The teacher-researcher was primarily interested in information gleaned from the data indicating an increase in student motivation and engagement in learning science concepts as well as an increase in science content knowledge in an outdoor setting. Therefore, the teacher-researcher specifically utilized NVivo process coding which examined words and phrases to capture student actions and though processes in students' own language (Saldana, 2013). The process of analyzing student engagement survey results enabled the teacher-researcher to reflect on student motivation, participation and learning as it related to the Problem of

Practice. The qualitative data were used primarily to provide context for the quantitative survey and assessment findings.

## Conclusion

This chapter provided an overview of the design of the study, methodology and data analysis. The setting of the research study was an elementary school in the South Carolina low country in which students studied local plant and animal characteristics, traits, and adaptations. A mixed methods approach was implemented as the teacher researcher incorporated qualitative and quantitative measures to collect data on twenty, fourth grade student participants. The data gathered were triangulated to compare and contrast across measures. Methods of coding were used to determine specific levels of motivation and engagement with the science content and to analyze data for emergent patterns. Because of the time constraints and sample size of the study, results were suggestive rather than conformational.

Based on the results of this study, the teacher-researcher developed an action plan that included a recommendation for the school and district to better utilize school grounds and local nature center as a resource for outdoor, experiential education four elementary students.

# CHAPTER FOUR

## PRESENTATION AND ANALYSIS OF DATA

Because science standardized test scores at the researcher's school have declined over the last eight years (Keefner, 2015) the teacher-researcher was proactive in researching effective methods of science instruction within the STEM framework. Research has shown that place-based, experiential, outdoor educational interventions may lead to an increase in students' attitude and engagement in learning science (Sobel, 2013; Smith, 2002b). Therefore, the goal of the teacher-researcher was to determine if increased student attitude and engagement may lead to gains in content knowledge utilizing the *From Seeds to Shoreline®* program.

Chapter Four of the dissertation presents the analysis of data collected using the mixed-methods research methodology detailed in the previous chapter. The process included a sample size of twenty student participants who were administered pre and post engagement surveys and content knowledge assessments. The students also participated in semi-structured, open response interviews. The research guiding this study were:

1. How does student participation in the *From Seeds to Shoreline®* program impact student attitude and engagement in learning science concepts?
2. What impact does the *From Seeds to Shoreline®* curriculum, an inquiry-based instructional program utilizing problem-solving, cooperative learning have on fourth grade students' science achievement?

The purpose of this study was to evaluate to what extent the *From Seeds to Shoreline*® outdoor education program impacted student attitude regarding science education, and the impact of student achievement of science content knowledge based on state science standards. The explicit objectives were to determine the effects of a place-based, experiential, outdoor science program within the framework of problem-based, cooperative learning on students' knowledge about natural science and evaluate effects of an outdoor, experiential, environmental science program on students' attitudes and motivation toward learning about the environment and science.

The action research study was significant in that it identified a potential component to increase student attitude and engagement in learning science and increasing science knowledge and understanding. Replacing traditional methods of science instruction with a more holistic, natural approach to learning natural science may positively impact student attitude, engagement and knowledge (Smith, 2002a). Cooperative learning groups, inquiry-based lessons utilizing experimentation to problem solve, and providing authentic and meaningful learning experiences are generally accepted STEM practices (Mannion, Fenwick, & Lynch, 2013).

## Data Collection Methods

During the six-week data collection period, the following steps were employed:

1. The teacher-researcher administered a Science Motivation and Engagement Survey (Skinner & Chi, 2017) on Google Forms to 20 student participants.
2. Science Measures of Academic Progress (MAP) was administered in the Fall, 2017. MAP data analysis informed the teacher-researcher as to what specific science standards should be addressed.

3. The teacher-researcher developed a USATestprep© assessment to address two specific science standards.
4. The teacher-researcher facilitated 10 authentic, experiential, outdoor learning experiences based on Seeds to Shoreline® curriculum along with teacher created lessons. During and after lessons, the teacher-researcher reviewed student journals and interview responses.
5. Student participants completed the Science Motivation and Engagement Post-Survey (Skinner & Chi, 2012) on Google Forms and the USATestprep© post-test at the conclusion of the action research cycle.
6. The Science MAP assessment was administered Spring, 2018.
7. The teacher-researcher compared data from three assessment tools: pre- and post-survey Science Motivation and Engagement Survey (Skinner & Chi, 2012), pretest and posttest USATestprep©, and pretest and posttest MAP assessment.
8. The teacher-research reviewed interviews to determine educational themes revealed.

The findings for each of the research questions are presented in this chapter. The findings specific to the objectives outlined are presented by addressing the first research question and analyzing data to determine competence, relatedness and autonomy, which relate to engagement in learning science (Skinner & Chi, 2012; Ryan & Deci, 2017). The second research question was addressed by analyzing specific, science content knowledge with standardized test questions and responses. Qualitative information collected through semi-structured interviews is presented to provide context for the findings.

For each research question, data from student surveys is presented. Students were surveyed at the beginning of the six-week science instructional and data collection period. Students were also surveyed following the *From Seeds to Shoreline®* program participation to determine the immediate impact of the program on their motivation to participate and learn science concepts.

Moreover, a pre and post assessment of standards-based objectives was administered to students at the beginning and end of the data collection period. Student achievement was also compared using data from Fall 2017 and Spring 2018 Measures of Academic Progress (MAP) assessments. Therefore, student survey responses and pre and post assessment data are presented to examine the impact of the *From Seeds to Shoreline®* program. Table 4.1 shows the types of survey data used to address the research questions.

Table 4.1 Survey and assessment data used to address each research question

| **Research Question (RQ)** | **Data Source** |
|---|---|
| RQ1: What impact does the *From Seeds to Shoreline®* program have on fourth grade students' attitude and engagement in learning science? | Student Survey<br>Student Interview |
| RQ2: What impact does the rom Seeds to Shoreline program have on fourth grade students' knowledge of natural science concepts? | Pre and Post USATestprep© Assessment<br>Fall and Spring MAP Assessment<br>Student Interview |

## Demographic Characteristics

The first data collected for the action research were demographic. Participants for this action research study were students assigned to the teacher-researcher's science class for the 2017-2018 school year. The demographic characteristics of the study participants presented in this section were collected from PowerSchool. There were 11 female students (55%) and 9 male students (45%). The racial and ethnicity makeup of the participants fell into four categories. Most students (55%) were ethnically Hispanic or Latino. There were 5 students identified as white (25%). Participants identified as black or other were evenly distributed with 2 students each, or (10%).

Of the 20 students 70% qualified for free and reduced lunch; 55% qualified for English as a Second Language (ESOL) services, and 45% were served in the ESOL program; 20% received additional literacy support; 15% received additional math support; one student was served with a 504 for academic accommodations; and one student was on a Response to Intervention (RIT) behavior plan.

## Intervention

Students participated in the *From Seeds to Shoreline*® program, which was developed to engage students in authentic, hands-on, outdoor science lessons (Bell, Binz, & Morganello, 2016). The teacher-researcher facilitated lessons outside in the school lab, school garden, and a nearby salt marsh. Student inquiry and learning focused on two specific science standards relating to the growth and development of organisms. The framework of the place-based, outdoor, experiential program included interdisciplinary learning and problem-based learning. Specifically, students participated in ten cooperative learning, authentic, relevant hands-on learning activities while outdoors.

## Analysis and Findings

This section of Chapter Four addressed the findings after data was collected from multiple instruments including the Science Motivation Survey, semi-structured and open response interviews, and pre and post assessments of content knowledge. Quantitative data were analyzed and presented based on the degree to which students were engaged and motivated to learn and changes in test scores. Qualitative data from student interviews were analyzed. Responses from student interviews were coded, sorting data and initial discoveries into categories. Data were thematically grouped based on NVivo coding of students spoken responses, observations, and questions. Therefore, the teacher-researcher captured student learning in their own words. This format was followed to address each research question.

## Research Question 1

How does participation in the *From Seeds to Shoreline®* program impact student attitude and engagement in learning science concepts?

### Participant Engagement Survey

To determine the impact of the *From Seeds to Shoreline®* program on student attitude toward learning science, participants were surveyed using scales to assess their perception of learning science and engagement in learning. The teacher-researcher administered pre and post student surveys to measure their motivation and interest by combining competence, relatedness, autonomy, and engagement. The teacher-researcher created scales assessing students' self-perceptions of science engagement based on Skinner and Chi's (2012) Science in the Learning Garden measures. The teacher-researcher calculated student perceptions by averaging student scale scores measuring student competence, relatedness, and autonomy as they primarily related to outdoor learning activities.

Student perception of *competence* was measured with six questions based on student perception of potential success in learning activities. Student perception of *relatedness* was measured with six survey questions based on student feeling of belonging and acceptance at school and as an outdoor learner. Student perception of *autonomy* was measured with six questions based on their feeling of personal motivation and pride in learning. Student *engagement* was measured with a six-question scale based on the enthusiasm and effort they perceived in their participation. Survey questions identified emotional and behavioral contributions to learning (Skinner & Chi, 2012).

The survey measures used in this action research study were based upon a model of motivational development as part of the Self-Determination Theory (SDT). SDT is a motivation and personality theory which relates to people's "inherent growth tendencies and innate psychological needs" (Ryan & Deci, 2000). Student motivation and attitude to learn was determined by a combination of competence, autonomy, and relatedness (Ryan & Deci, 2017; Skinner & Chi, 2012). Learning competence, autonomy, and relatedness were measured with a student survey using a Likert scale ranging from 1 (not at all true) to 5 (totally true). Each construct of attitude and motivation toward learning are presented individually, beginning with *competence*. Table 4.2 shows the percentage of student reported science competence on pre-survey and post-survey questions.

Table. 4.2 Competence Percentages

| Statement | Not at all true | | A little bit true | | Somewhat true | | Fairly true | | Totally true | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| I can get good grades in school. | 0 | 0 | 5 | 5 | 10 | 25 | 35 | 40 | 10 | 30 |
| If I decide to learn something hard, I can. | 0 | 0 | 15 | 15 | 30 | 30 | 45 | 35 | 10 | 20 |

(continued)

Table. 4.2 Competence Percentages (continued)

| Statement | Not at all true | | A little bit true | | Somewhat true | | Fairly true | | Totally true | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| I can do well in school if I want to. | 0 | 0 | 10 | 5 | 40 | 35 | 45 | 35 | 10 | 25 |
| I am good at gardening and working outdoors. | 5 | 0 | 5 | 0 | 40 | 20 | 35 | 35 | 15 | 45 |
| I know a lot about gardening and working in the saltmarsh. | 10 | 0 | 10 | 0 | 55 | 15 | 25 | 45 | 0% | 40 |
| I can identify plants and animals in our lab, garden, and the saltmarsh. | 5 | 0 | 30 | 0% | 25 | 10 | 30 | 20 | 10 | 70 |

Representing the survey data by percentage depicted the change in student responses from pre-survey to post-survey. The item measuring participant perceived ability to earn good grades changed from 55% affirmative on the pre-survey to 70% on the post-survey. Additionally, student responses indicated an increase in confidence in their perceived ability to garden and work outdoors from 50% affirmative on the pre-survey to 80% on the post-survey.

Survey data of student self-assessment in competency is illustrated on a Figure 4.1. Utilizing a bar graph was appropriate as it clearly depicts the student-reported level of competence regarding academic performance and outdoor learning. Changes in affirmative responses from pre-survey to post-survey are displayed in Figure 4.1.

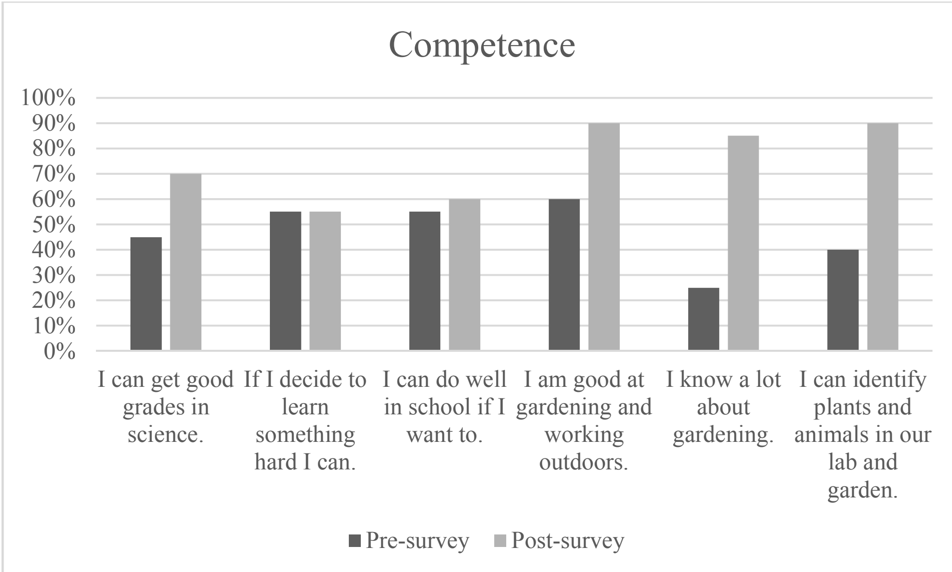


Figure 4.1: Change in self-assessment of competency

Figure 4.1 revealed that in the construct of competence, student feelings of competence increased from the pre-survey to the post survey in all six questions. Students indicated a change in Question 6 in their ability to "identify plants and animals in the lab, garden, and salt marsh." Pre-survey results were 40% affirmative while post-survey results were 90% affirmative. The response that indicated the greatest increase refers to Question 5: *I know a lot about gardening and working outdoors.* On the pre-survey, 25% of student response concerning knowledge of gardening and working outdoors was positive. However, following the *From Seeds to Shoreline*® program, 85% of student response was positive. However, responses to Question 2: *If I decide to learn something hard I can* did not increase from the pre-survey to post-survey as positive responses remained constant at 55%. This indicated that in the six areas of student academic and science confidence measured, there was an increase in student academic and science confidence after implementing the *From Seeds to Shoreline*® program.

**Theme 1: Lack of experience and exposure to the outdoor lab, garden and salt marsh.**

The first theme revealed by student interviews was a high level of student apprehension and uncertainty regarding competency in learning about new topics in an unfamiliar setting. While students were excited to learn in an outdoor setting, many students questioned expectations and their competency. Jason asked, “Do big spiders, like tarantulas live in the marsh? Cause if they do, I don’t want to learn about that.” Carmen said she gardened with her grandmother, but she did not think “*regular* plants grow in the salt marsh.” She expressed concern that she may not be able to learn all the names of “weird” plants and animals. Mark expressed excitement about building a greenhouse and planting a garden; however, he asked if the trip to the salt marsh to transplant spartina alterniflora was required. He stated, “the marsh stinks” and he heard “people sometimes get lost there.” On the pre-survey, 10% of the students expressed confidence in their competency to “identify plants and animals in out lab, garden, and saltmarsh.” At the end of the place-based education treatment, 70% of respondents agreed it was “totally true” they can identify those plants and animals. Overall, students entered the *From Seeds to Shoreline*® program with excitement and trepidation in their ability to master some of the expected outcomes. Laura exclaimed, “I never knew so many kinds of different things live in the marsh, but it makes sense with the prey and predators, and the salt water that everything is where it is supposed to be. It’s easy to learn what lives there ‘cause it all makes sense when you think about it.”

A second construct of the Self Determination Theory (SDT) relating to student motivation for learning was *relatedness* (Ryan & Deci, 2017). Relatedness, or connection, is the need to have close relationships with others (Ryan & Deci, 2017). Student participants responded to six questions to measure their relationship to the outdoor learning lab, school garden, the class, the school, their friends, and their future. Results were organized on Table 4.3 showing the percentage of responses 1 (not at all true) to 5 (totally true) to six questions concerning relatedness on the pre-survey and post-survey.

Table. 4.3: Relatedness Percentages

| Statement | Not at all true | | A little bit true | | Somewhat true | | Fairly true | | Totally true | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| I feel like a real part of the outdoor lab and garden. | 5 | 0 | 0 | 5 | 65 | 10 | 25 | 45 | 5 | 45 |
| The outdoor lab, garden, and marsh are good places for students like me. | 0 | 0 | 10 | 15 | 40 | 5 | 30 | 40 | 20 | 55 |
| I feel like a real part of this school. | 0 | 0 | 5 | 5 | 35 | 5 | 45 | 40 | 15 | 50 |
| This school is a good place for students like me. | 0 | 0 | 0 | 5 | 10 | 5 | 70 | 35 | 20 | 55 |
| I need to learn a lot in school, so I can take charge of my future. | 0 | 0 | 0 | 0 | 20 | 20 | 50 | 30 | 30 | 50 |
| I feel close to my friends. | 0 | 0 | 5 | 0 | 15 | 10 | 35 | 25 | 45 | 65 |

Representing the survey data by percentage depicts the change in student responses from pre-survey to post-survey. Responses noted on Table 4.3 show student participants felt a sense of connection to the class and school. Based on the item measuring student perception of being a part of the outdoor learning and garden community, students indicated a change from 30% affirmative on the pre-survey to 95% on the post-survey. Another response of interest was a change in feeling "like a real part of this school." Students' perception of being "part of this school" changed from 60% affirmative on the pre-survey to 90% on the post-survey.

Survey data of student self-assessment of relatedness was illustrated in Figure 4.2. Utilizing a bar graph was appropriate as it clearly depicts the student-reported level of relatedness regarding their sense of connection with classmates and the school. Changes in affirmative responses from pre-survey to post-survey are displayed in Figure 4.2.

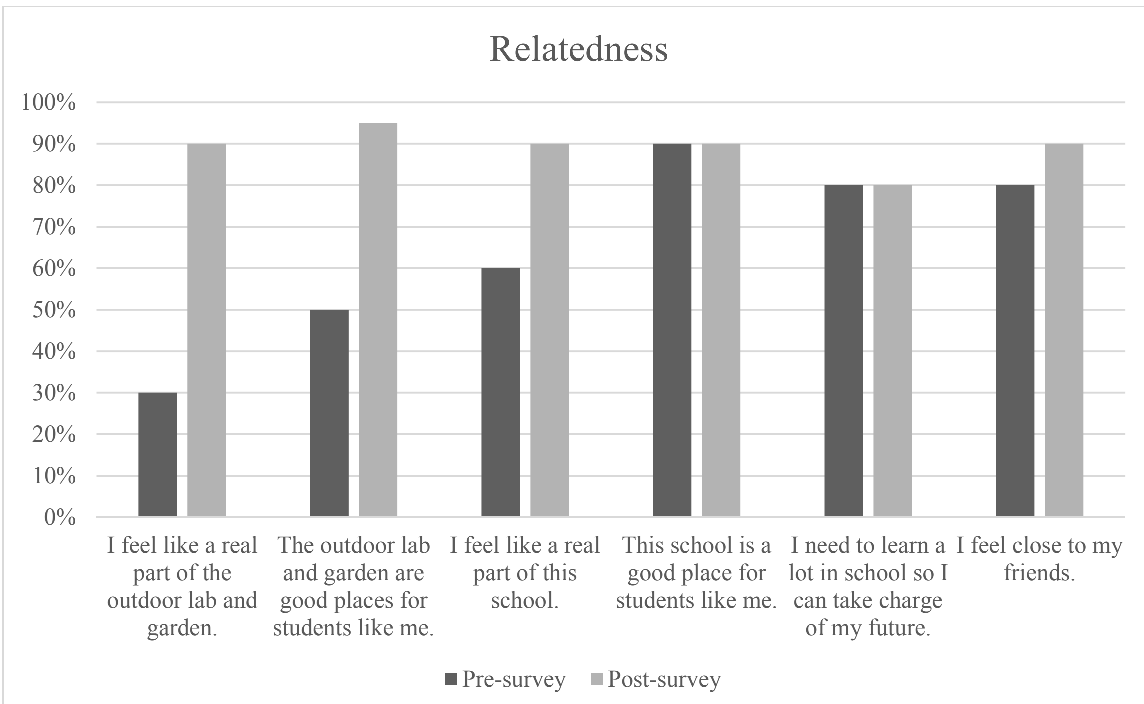


Figure 4.2: Change in self-assessment of relatedness

Figure 4.2 revealed student feelings of relatedness increased from the pre-survey to the post survey in four of the six questions. The responses that indicated the greatest increase refers to Questions 1 and 2 which identify the level to which students felt a part of the outdoor learning lab and garden. Question 3 asked students to identify to what degree they felt a part of the school. On the pre-survey, 60% of student response affirm they "feel like a real part of the school" and 90% of student response affirms on the post-survey. Student responses to questions 4 and 5 did not elicit an increase in positive responses on the post-survey. Students acknowledged there was no increase in their perception that *this school is a good place for students like me* and *I need to learn a lot in school so I can take charge of my future*. However, in four of the six areas of student academic and science relatedness measured, there was an increase in student academic and science relatedness after implementing the *From Seeds to Shoreline®* program.

**Theme 2: Relating to classmates in a positive learning environment**

While students expressed excitement about learning outdoors in the school lab, garden, and saltmarsh, they expressed concern about their relationships with classmates. Callie asked if all students would work together in the garden. She hypothesized that several students may not be able to "get it together" and control themselves in a less structured environment. By the end of the *From Seeds to Shoreline®* program, Callie admired the work of her assigned group. She gave a shout out to Dakota and Henry for working together so their team was successful in all the salt marsh projects. Amy shared that she and Eddie had never been to the salt marsh. She requested Eddie always be her assigned partner, so they could work together. During the first interview at the beginning of the program, Henry admitted he was not certain he would be successful in working in the outdoor lab, the school garden, or the marsh. He stated, "I'm not doing good in fourth grade; I'm not as smart as I used to be." He followed up by asking, "Do you think other kids will let me be part of their group?" By the end of the program, Henry proudly exclaimed with a high level of confidence, "I told them (classmates) I could do it. They listened to me when we were trying to figure out the stripes on the grass." At the end of the interview, Henry clearly stated, "We should spend more time out in the lab and out in the marsh…it's better." His comments specifically addressed the second relatedness survey question that "the outdoor lab, school garden, and saltmarsh are good places for students like me." Henry did not feel like an integral part of school until he demonstrated his ability to work well outside. For many students, place-based, outdoor, experiential learning is culturally responsive and is tailored to learning to students' strengths, needs, and interests (Ladson-Billings, 1994).

**Theme 3: Connection to where we live**

Even as many students articulated their fear and concern at the beginning of the unit, an appreciation for their environment emerged. Kevin lives near the marsh and his family is actively involved in boating, crabbing, and fishing. He took a leadership role in helping students new to the marsh navigate the different learning environment. To prepare for the trip to the saltmarsh, Kevin brought in some of his marsh treasures: oyster shells, periwinkle snail shells, crab shells, and a racoon skull. Students unfamiliar with marsh wildlife could touch and feel the animal remains. Even though he was a normally quiet and shy student, Kevin took great pride in explaining where and how he came to obtain his treasures. He offered to help students search for interesting shells and wildlife.

Even though Beaufort County is filled with 200,000 acres of saltmarsh, over 50% of the student participants reported they never explored the marsh. Patrick recently moved from a midwestern state, he and had simply not had the opportunity to walk through the pluff mud. When the class visited the marsh as the tide was receding, Patrick's water shoe was sucked into the pluff mud. He was determined to pull it out, as his mantra was "to leave it like he found it." Patrick had grown to appreciate his new home. Louisa and Mario often fish around the waterways with their families, and Derrick's grandfather was a shrimper. Derrick brought in photos of his grandfather's shrimp boat and opened the discussion of the economic impact of the saltmarsh in our county. The school garden and saltmarsh encouraged students to relate their learning to their personal lives. Smith (2013) claimed that place-based education offers a "means to engender among students a sense of affiliation with their home communities and regions."

The third component of the Self Determination Theory related to student motivation for learning was autonomy (Skinner & Chi, 2012). Students in control of their own behaviors and learning may experience a higher degree of motivation to learn (Reeve, 2002). Student participants responded to five questions to measure the degree to which they felt control over what and how they learn. Results from the pre-survey and post-survey were listed on Table 4.4 showing the percentage of responses from 1 (not at all true) to 5 (totally true).

Table. 4.4: Autonomy Percentages

| Statement | Not at all true | | A little bit true | | Somewhat true | | Fairly true | | Totally true | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| I learn about plants and animals because I enjoy it. | 0 | 0 | 5 | 0 | 15 | 0 | 65 | 50 | 15 | 50 |
| It's cool to see things grow. | 0 | 0 | 0 | 0 | 50 | 0 | 40 | 15 | 10 | 85 |
| I garden so I can learn important things. | 0 | 0 | 0 | 0 | 25 | 0 | 45 | 30 | 30 | 70 |

(continued)

Table. 4.4: Autonomy Percentages (continued)

| Statement | Not at all true | | A little bit true | | Somewhat true | | Fairly true | | Totally true | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Our teacher said I had to work in the garden and the saltmarsh, otherwise I probably would not. | 5 | 10 | 15 | 10 | 65 | 35 | 5 | 20 | 10 | 25 |
| By working in the garden and saltmarsh, we can make the world a better place. | 0 | 0 | 5 | 0 | 40 | 5 | 15 | 50 | 40 | 45 |
| Doing well in the garden and the saltmarsh is important to me. | 0 | 0 | 0 | 0 | 15 | 15 | 35 | 40 | 50 | 45 |

Representing the survey data by percentage depicted the change in student responses from pre-survey to post-survey. The items measuring participant perceived ability to take ownership of their learning in the context of the outdoor lab, garden, and saltmarsh showed an increase across all six areas. The student participants indicated their perceived ability to “garden so they can learn important things” changed from 75% affirmative on the pre-survey to 100% on the post-survey. Additionally, student responses indicated change in confidence that “by working in the garden and saltmarsh, we can make the world a better place” from 65% affirmative on the pre-survey to 95% affirmative on the post-survey.

Survey data of student self-assessment of autonomy is illustrated on a Figure 4.3. Utilizing a bar graph to display the information is appropriate as it clearly depicts the levels student-reported level of autonomy regarding academic performance and outdoor learning. Changes in affirmative responses from pre-survey to post-survey are displayed in Figure 4.3.

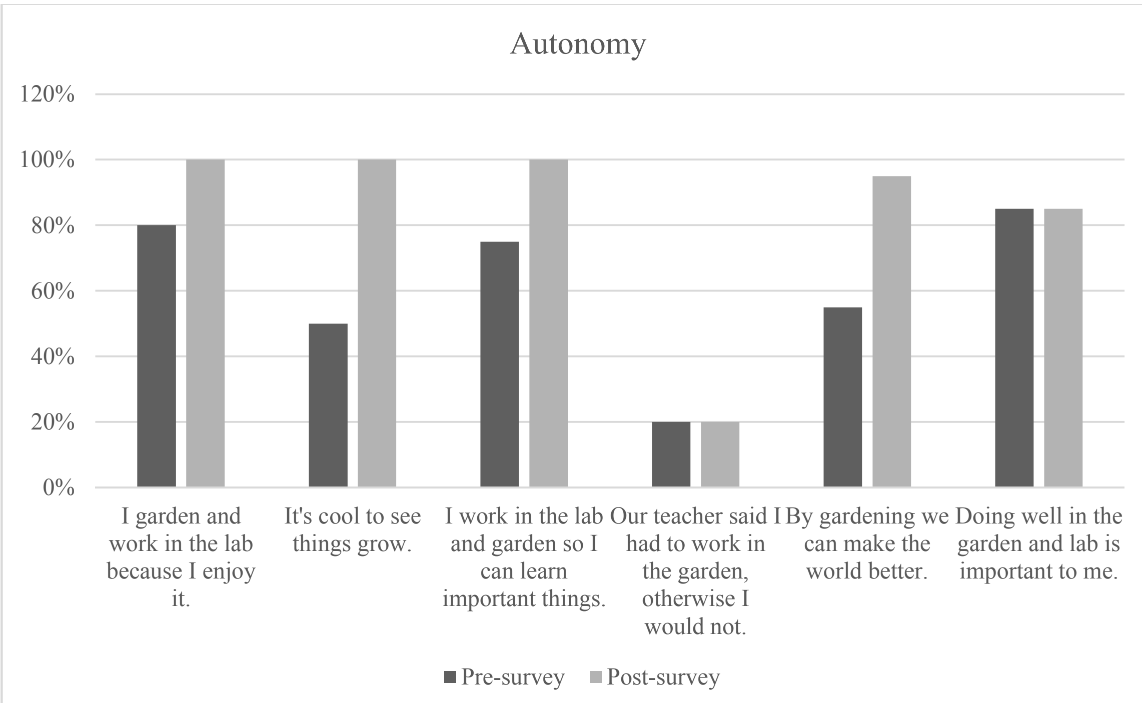


Figure 4.3: Change in self-assessment of autonomy

Figure 4.3 revealed that relating to autonomy, student feelings of ownership of their behaviors or learning increased from the pre-survey to the post survey in five of the six survey questions. Question 1 addressed working outdoors for enjoyment. Affirmative responses to Question 1 increased from 80% on the pre-survey to 100% on the post-survey. The response that indicated the greatest increase refers to Question 2: *It's cool to see things grow.* On the pre-survey, 50% of student response concerning the transformation of plants was positive. However, following the *From Seeds to Shoreline®*

program, 100% of student response was positive concerning the observation of plant growth. Post-survey response to Question 3 indicated all students recognized the value of outdoor learning as 100% of the participants affirmed they *work in the lab and garden to learn important things*. There was no change in the response to Question 4 indicating *Our teacher said I had to work in the garden, otherwise I would not.* Responses to Question 5 indicated an increase in student acknowledgement that *by gardening, we can make the world a better place.* Finally, there was no increase in positive responses from pre-survey to post-survey in *doing well in the garden and lab is important to me*. This indicated that in four metrics of autonomy, there was an increase in ownership of learning as a result of implementing the *From Seeds to Shoreline®* program.

Outdoor learning engagement was measured using a 6-item scale to determine students' effort in participating in the learning activities. The results were displayed in Table 4.5.

Table. 4.5: Engagement Percentages

| Statement | Not at all true | | A little bit true | | Somewhat true | | Fairly true | | Totally true | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| When we are working outside, I listen carefully to our teacher. | 0 | 0 | 0 | 0 | 35 | 15 | 40 | 35 | 25 | 45 |
| The outdoor lab, garden, and saltmarsh are interesting. | 0 | 0 | 5 | 0 | 25 | 0 | 35 | 40 | 35 | 60 |

(continued)

Table. 4.5: Engagement Percentages (continued)

| Statement | Not at all true | | A little bit true | | Somewhat true | | Fairly true | | Totally true | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| The outdoor lab, garden, and saltmarsh are interesting. | 0 | 0 | 5 | 0 | 25 | 0 | 35 | 40 | 35 | 60 |
| I work as hard as I can in science. | 0 | 0 | 0 | 0 | 20 | 10 | 50 | 50 | 30 | 40 |
| My science teacher enjoys teaching us about science. | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 25 | 75 | 75 |
| I try to do well in school. | 0 | 0 | 0 | 0 | 20 | 15 | 45 | 40 | 35 | 45 |
| I look forward to coming to school. | 0 | 0 | 0 | 0 | 30 | 10 | 55 | 50 | 15 | 40 |

Items assessed on the pre-survey and post-survey included emotional and behavioral self-assessment. For example, students assessed their attentiveness, “When we are working outside, I listen carefully to our teacher.” On the pre-survey, 65% of student responses were affirmative. The post-survey indicated a change to 80% affirmative responses. Response to “The outdoor lab and garden are interesting” was 70% predicted affirmative and increased to 100% affirmative response in the post-survey.

Figure 4.4 revealed that student participants indicated more interest in working in the outdoor lab and garden. When asked of students listen carefully to the teacher during outdoor learning, positive responses increased from 65% on the pre-survey to 80% on the post-survey. Pre-survey results indicated 65% of the participants anticipated the outdoor lab and garden would be interesting. Post-survey results indicated 100% of participants

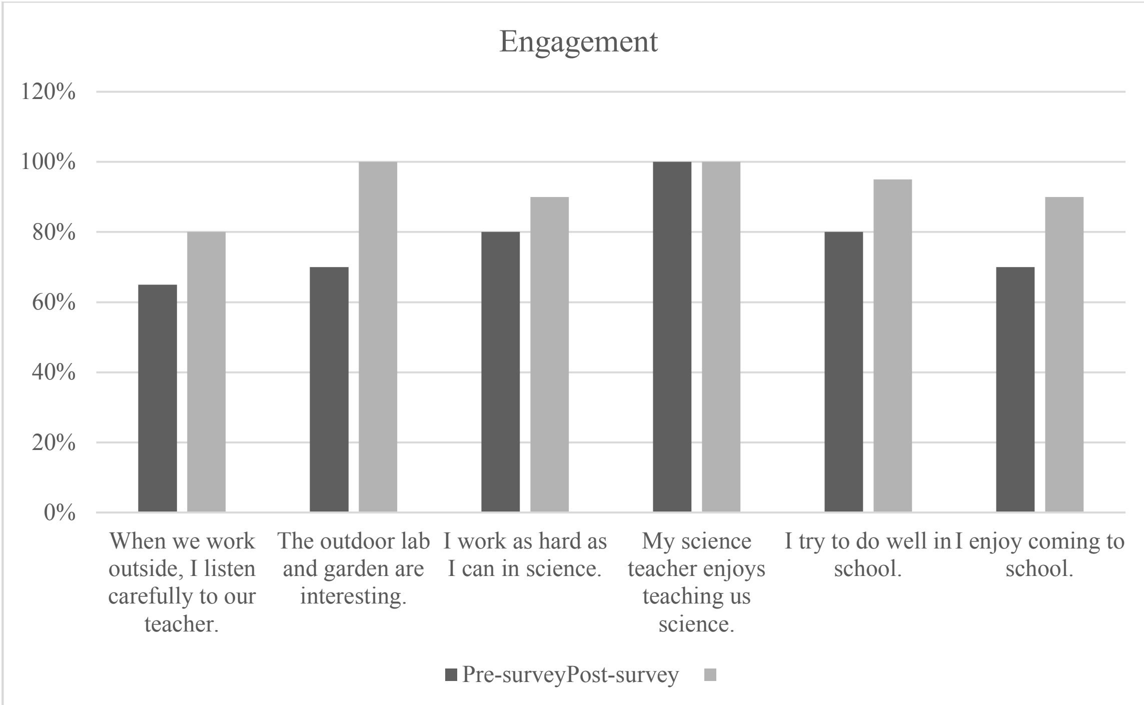


*Figure 4.4:* Change in self-assessment of engagement

found working in the outdoor lab and garden were interesting. There was a smaller increase in positive responses to Question 3 which indicated I work as hard as I can in science. Pre-survey results indicated 80% of students work as hard as they can, and 90% indicated they work hard on the post-survey. On both pre-survey and post-surveys, all participants recognized their teacher enjoyed teaching science. Additionally, student responses indicated an increase in Question 5 *trying to do well in school* and Question 6 *enjoy coming to school*. Based on student responses to the pre-survey and post-survey, student engagement increased after implementing *From Seeds to Shoreline®.*

**Theme 4. Stewardship**

As a result of this action research study, students became more aware of human impact on the saltmarsh. Derrick introduced the economic impact of the saltmarsh on our local economy as he led the investigation on local business and industry. During the field excursion to the saltmarsh, students were dismayed to see plastic strewn in the marsh. Summer tried to retrieve a plastic cup wedged in some marsh grass and suggested an organized litter clean up. In the second round of interviews, several students indicated a desire to learn about plastic in the saltmarsh. This is an example of the power of place leading to a question and an investigation to solve a problem. Students led an inquiry and engaged in problem-based learning to determine the impact of plastic in the marsh. Laura and Carmen worked together to research the plastic problem, collect data based on a litter count on the field excursion, and present their findings to the class using Google Slides. Laura and Carmen explained in a video report how plastics break down into small particles called microplastics and eventually end up in our marshes and oceans. Students responded to their own engaging and complex problem to extend the learning and create an additional authentic, meaningful learning experience. Many of the student participants agreed with Sobel (2013) when he stated, "You don't learn about ecology so you can help nature in the future. You learn so you can make a difference here and now" (p. 18).

Student positive reactions to learning experiences within the *From Seeds to Shoreline*® framework may be a motivating factor to empower them to master science concepts. Many students indicated limited experience with growing plants and identifying organisms in the saltmarsh before the *From Seeds to Shoreline*® program. Student-participants' comments demonstrated their understanding of lessons and an appreciation for the learning environment. Thus, their motivation and engagement in learning science concepts was positively influenced.

## Research Question 2

What impact does the *From Seeds to Shoreline®* have on fourth grade students' knowledge of science concepts?

**Participant Achievement Scores**

Student Measure of Academic Progress (MAP) scores were collected after Fall 2017 and Spring 2018 administrations. MAP scores are reported by two measures. First, student achievement was measured using the Rasch unit or (RIT). A RIT score is an estimation of student instructional level. Additionally, MAP measured science achievement with a percentile rank from 1-99. For comparison purpose, RIT scores were used to observe scores based on science content knowledge on Table 4.6.

Table 4.6: Science MAP scores

| Testing Date | Mean RIT | SD | Min | Max |
|---|---|---|---|---|
| Fall 2017 | 196.65 | 7.93 | 175 | 208 |
| Spring 2018 | 206.90 | 8.30 | 191 | 218 |

MAP RIT scores are illustrated on Figure 4.5 to clearly demonstrate the increase in science content knowledge from Fall, 2017 to Spring, 2018.

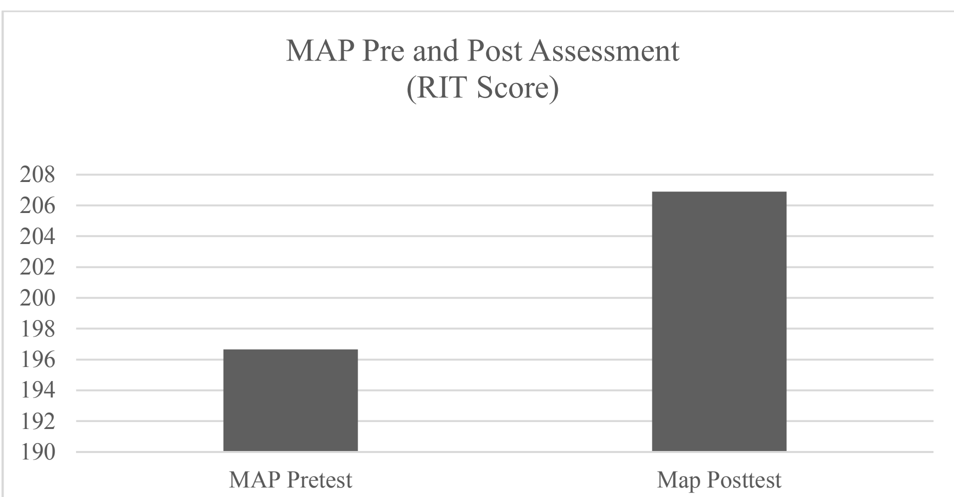


Figure 4.5: MAP Scores

The raw test scores were paired for each student and the difference was analyzed. Pre-test and post-test data were collected on all student participants. The bar graph on Figure 4.5 revealed student mean pre-test score was 195.65. The mean posttest score was 206.90. Overall student growth increased 10.25 points from 196.65 to 206.9.

**T-test**

A matched pair t-test was used to determine if the difference between the average Fall 2017 and Spring 2018 MAP RIT scores was significant.

Difference (D) = $X_{spring} - X_{fall}$

$Mean_D = 10.25$

Standard $Deviation_D = 9.174$

$t = 2.961$

p value = .000142

The t-test is appropriate because it compares raw pre-test and posttest data paired from each student. The calculated difference was analyzed using a t-test. At the 5% significance level, these findings were significant. It was concluded the Fall 2017 and Spring 2018 MAP RIT scores are significantly different. Therefore, there was a significant difference between the content mastered prior to fourth grade science instruction and after instruction.

NWEA published MAP norms in 2015 which indicates fourth grade students are expected to begin the year with a mean score of 194.6 and end the year with a mean score of 201.0. Expected MAP science growth for fourth grade students is 5.4 points from fall to spring. The comparison of student participant MAP scores with nationally normed MAP scores are illustrated in Figure 4.6

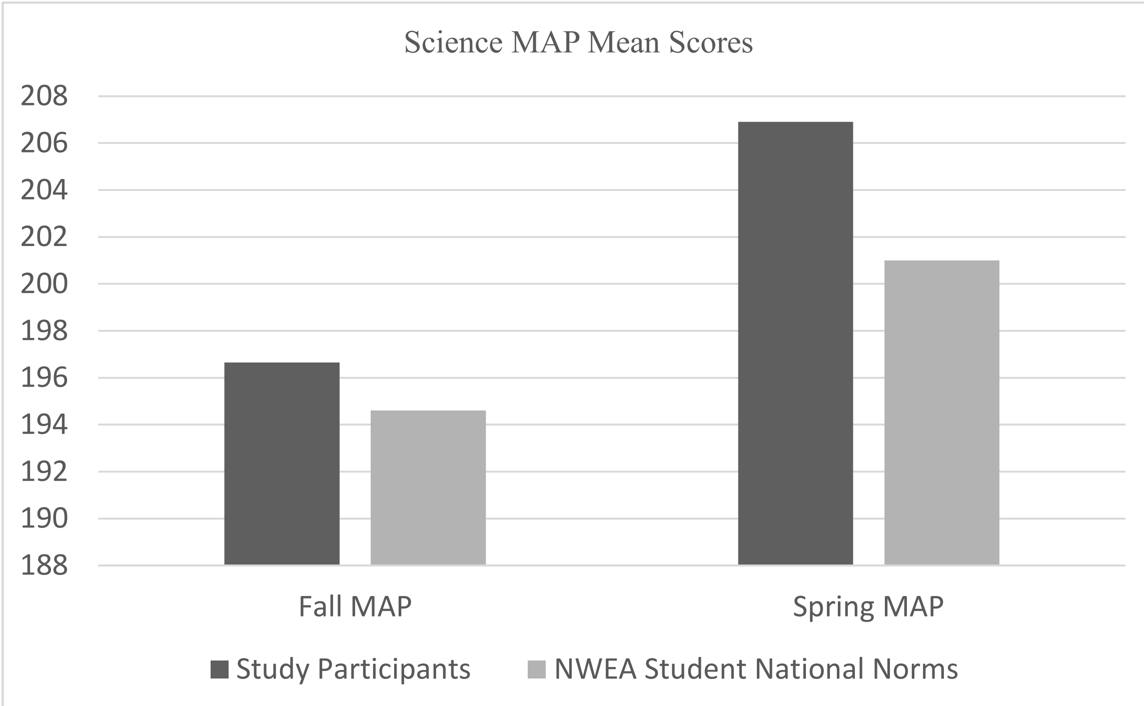


Figure 4.6 Comparison of Science MAP Mean Scores

Figure 4.6 indicated study participants began the year with higher science MAP scores than the national average. Study participants started with a mean score of 196.6 which is two points higher compared to the national average of 194.6. The spring mean MAP score of 206.9 after *the From Seeds to Shoreline®* program indicated a higher growth than expected by NWEA. The national mean score at the end of the year is expected at 201. NWEA indicated an expected growth of 5.4 points. *From Seeds to Shoreline®* participants mean MAP scores increased by 10.25 points.

For a more specific examination of test scores based on the two standards addressed with the *From Seeds to Shoreline®* program, USATestprep© standardized testing was utilized. Content knowledge assessed was limited to the characteristics, development and growth of organisms. Data relating to the USATestprep© pre-test and posttest were indicated on Table 4.7.

Table 4.7: USATestprep© scores

| Test Administration | Mean Number Correct | SD | Min | Max |
|---|---|---|---|---|
| Spring 2018 Pre-test | 8.40 | 2.89 | 3 | 14 |
| Spring 2018 Posttest | 16.65 | 2.38 | 10 | 20 |

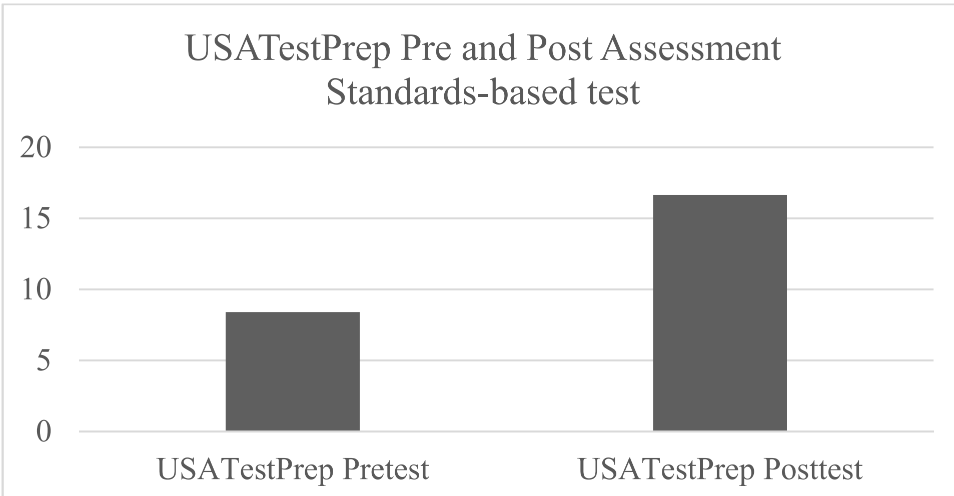


Figure 4.7: USATestprep© scores

Raw test scores were paired for each student and the differences were analyzed. Pre-test and posttest results were collected from all 20 participants. Results were graphed on Figure 4.6 which indicated an 8.25-point increase from the mean pre-test score of 8.40 (number of correct responses) to the mean posttest score of 16.65.

**T-test**

A matched pair t-test was used to determine if the difference between the USATestprep© unit pre-test and posttest scores was significant.

Difference (D) = $X_{posttest} - X_{pre\text{-}test}$

$Mean_D = 8.25$

Standard $Deviation_D = 4.997$

$t = 7.719$

p value = .0001907

The t-test was appropriate because it compared raw pre-test and posttest data paired from each student. The calculated difference was analyzed using a t-test. At the 5% significance level, these findings were significant. It can be concluded the USATestprep© pretest and postttest scores were significantly different. Therefore, there was a significant difference between the content mastered prior to the outdoor, experiential instruction and after instruction.

**Theme 5. Academic Rigor**

By connecting student learning to an authentic, place-based environment, students had the opportunity to practice scientific concepts, work with science equipment, and extend scientific vocabulary in accurate and meaningful ways. Sobel (2013) lamented, “geography is taught using pretty pictures of faraway places” (p. 8) and science instruction is often reduced to vocabulary lists (Smith, 2002b). While dissecting a squid, Frederick (often an impulsive student) reminded his lab partner to “carefully put down the ‘scalpel’ and review the directions” to ensure they would observe the “invertebrate anatomy and anything interesting in its guts.” Not only did Frederick demonstrate accurate use of vocabulary terms, he also led his colleague in proper use of science equipment. Spurred on by the realization that organisms have specific scientific names, students displayed great interest in learning precise names for various saltmarsh plants and animals. Throughout the learning unit, students proudly demonstrated their expertise on a variety of topics. Normally quiet and reserved in class, Amy was recognized as the class expert on planting seedlings. Students deferred to Amy for advice on how deep to dig the hole and to estimate the distance for planting the next seedling. Alicia organized the watering schedule. She kept copious notes of team members who completed the favorite task of watering the garden, and who would participate on the next rotation. Many students demonstrated increasingly improved measurement skills and how to transfer those skills for deeper learning. During an interview, Michael mentioned that he "figured out the area of the garden when we multiplied the two sides of the wood together. So I could figure out how big the plastic square was around all those organisms in the marsh."

## Analysis of Data Based on Research Questions

The research questions for the action research study were:

1. How does student participation in the *From Seeds to Shoreline®* program impact student attitude and engagement in learning science concepts?
2. What impact does the *From Seeds to Shoreline®* program, an inquiry-based instructional program utilizing problem-solving, cooperative learning have on fourth grade students' science achievement?

There were two specific research objectives of this action research study. First, the teacher-researcher aimed to determine the effects of an outdoor, experiential environmental science program within the framework of problem-based, cooperative learning on students' knowledge about natural science. Second, the teacher-researcher evaluated effects of an outdoor, experiential, environmental science program on students' attitudes toward the environment and science.

Based on Science Motivation and Engagement Pre-Survey and post-survey results, there were observable, affirmative changes in students' attitude and engagement toward learning and participating in science. The findings of the pre and post survey results suggested that there was a significant increase in all areas of student interest and motivation: competence, autonomy, relatedness, and engagement. Qualitative data from student interviews confirmed the positive changes in student science motivation and engagement.

Positive gains were observed in both the MAP data and USATestprep© data which indicated growth in learning science content. The scores on both sets of tests were determined to be significantly different. Qualitative data from student interviews confirmed positive changes in student academic achievement.

The combination of these four data sources suggested that student participation in the *From Seeds to Shoreline®* experiential, outdoor education program had a positive impact on student interest and motivation in learning science and increases in learning science content.

## Conclusion

The data presented and analyzed in Chapter Four represented findings from a mixed-methods study designed to determine the potential impact of a place-based, experiential, outdoor, educational curriculum, such as *From Seeds to Shoreline®* had on student attitude and engagement toward learning fourth grade science concepts. The teacher-researcher collected data from surveys, test scores, and student interviews. Triangulation of the data indicated statistical differences in student pretest and posttest scores.

Key themes emerges through the process of data collection and analysis. These four themes influenced student attitude and engagement in science learning and science content knowledge. These themes included the importance of student exploration of their natural surroundings, access to interdisciplinary, inquiry and problem-based learning, and meaningful, authentic learning experiences for all students. Because the data revealed there are noticeable differences between groups of students within the class, emphasis should be considered on engaging all students in place-based educational opportunities.

Based on the findings analyzed in this chapter, an action plan is developed in Chapter Five. The action plan outlines implications for practice and future research.

# CHAPTER FIVE

# IMPLICATIONS AND RECOMMENDATIONS

The final chapter of the study reviewed the problem of practice, significance of the study, and theoretical framework concerning the *From Seeds to Shoreline®* curriculum. The study methodology was reviewed, including the sample characteristics, data collection methods, data analysis results, and specific responses to the research questions. Additionally, the results of the *From Seeds to Shoreline®* investigation were related to the literature reviewed in Chapter Two that formed the theoretical framework of the study.

More importantly, this chapter investigated the context of the teacher-researcher's advocacy of place-based education as a viable approach to invigorating STEM opportunities for elementary students. STEM lessons are generally taught through active engagement as students problem-solve and grapple with real-world issues by doing science (Kelley & Knowles, 2016). Programs such as *From Seeds to Shoreline®* engage students in science practices while connecting science to their daily lives.

## Overview of the Study

This mixed-methods study was designed to determine the potential impact of a place-based, experiential, outdoor, educational curriculum, such as *From Seeds to Shoreline®* had on student attitude and engagement toward learning fourth grade science concepts.

## Problem of Practice

The problem of practice identified was lack of opportunities for student engagement in meaningful science learning experiences and, as a result, declining standardized science test scores at a low country elementary school. While there has been a recent emphasis on STEM integrated education, it is necessary to determine the best approach for teaching science (English, 2017). The teacher-researcher examined the impact of a place-based learning program carried out in a local, outdoor environment. The researcher aimed to determine the impact of the *From Seeds to Shoreline®* program on student interest in learning science and their science knowledge and content achievement.

This place-based education program evaluation sought to determine the impact of the *From Seeds to Shoreline®* program on the level of engagement and science content mastery for a class of fourth grade students. Two research questions guided the study:

1. What is the impact of the *From Seeds to Shoreline®* program on student attitude and engagement in learning science?
2. What is the impact of the *From Seeds to Shoreline®®* program on student science achievement?

To effectively answer the research questions, the teacher-researcher reviewed the literature to identify relevant studies that addressed these concerns. Specifically, the researcher concentrated on studies which (1) examined the history, context, and theoretical constructs to ground the study; (2) promoted appreciation and conservation of place for a diverse group of students; (3) suggested effective methodologies and practices related to place-based education to increase student engagement and achievement; and

(4) presented recommendations for relating place-based education to diverse groups of students and communities. The review of the literature closely aligned with the teacher-researcher's educational goals and the purpose of the action research study. The purpose of the action research study was to determine the impact of the *From Seeds to Shoreline®* program on student engagement and achievement in learning science.

**Significance of the Study**

The significance of the study was to determine how the *From Seeds to Shoreline®* program supported and aligned with place-based education to provide measurable academic achievement in science; increase interest and enthusiasm about science-based learning; and promote appreciation and a sense of conservation and stewardship among students.

**Sample Characteristics**

The target group for the action research study were 20 students assigned to the teacher-researchers' class during the 2017-2018 school year. There were 11 female students (55%) and 9 male students (45%). The racial and ethnicity makeup of the participants fell into four categories. The majority of students (55%) were ethnically Hispanic or Latino. There were 5 students identified as white (25%). Participants identified as black or other were evenly distributed with 2 students each, or (10%). Fourteen students, or 70% qualified for free and reduced lunch; 55% qualified for English as a Second Language (ESOL) services, and 45% were served in the ESOL program; 20% received additional literacy support; 15% received additional math support; one student was served with a 504 for academic accommodations; and one student was on a Response to Intervention (RIT) behavior plan.

**Data Collection Methods**

The first question was addressed through multiple data points including: pre and post student attitude and engagement surveys, and interviews with twenty student participants. The teacher-researcher used Microsoft Excel and StatCrunch to organize and compute the survey data. NVivo software was used to organize and code student pre and post interviews. Several key themes emerged as a result of the NVivo coding process. These key themes influenced students' competency, relatedness and autonomy as factors in their engagement to learn science concepts.

The second research question was also addressed through multiple data points including: a review of theoretical place-based education literature and the effect on student achievement, and pre and post student achievement data from two standardized tests. The data reveled a positive change in student achievement outcomes specifically relating to fourth grade science learning standards.

## Results Related to Existing Literature

Place-based educational approaches have recently experienced a renewal as educators search for effective STEM related approaches (Malone, 2016). Place-based learning incorporates a variety of educational practices and purposes, including experiential learning, contextual learning, problem-solving learning, constructivism, outdoor education, indigenous education, environmental and ecological education, bioregional education, democratic education, multicultural education, and service learning (Gruenewald, 2003a; Smith 2002a). The most distinctive element of place-based education is the way in which curriculum adapts to unique characteristics of a particular place, or community. Typically, the environment provides the context for learning in place-based learning, while natural and cultural history provide a curriculum base for place-based education (Sobel, 2013).

The local proximity to over 200,000 acres of salt marsh, was a unique qualifier for utilizing the salt marsh as the context for learning. Student engagement and learning higher-order science concepts began with understanding the very foundation of the salt marsh – beginning with the pluff mud.

A review of the literature indicates place-based educational approach occurring in a wide variety of settings has positive effects on educational outcomes (Lieberman & Hoody, 1998; Williams & Dixon, 2013; Stern, Powell, & Hill, 2014; Powell & Wells, 2002; PEEC, 2010). While there are many effective evidence-based practices related to STEM instruction, place-based education utilizes the power of place to impact student engagement and achievement (Sobel, 2013).

*From Seeds to Shoreline®* is an example of a learning strategy that incorporates many significant components of place-based education. Based on information gleaned from a literature review, the teacher-researcher determined five components identify learning as place-based.

**Place.** Student learning is grounded in the local community – within the 200,000 acres of saltmarsh surrounding the place where these students.

**Student-centered.** Learning experiences are student-centered. Students had a voice in determining what and how they learned as they explored the outdoor lab, school garden, and saltmarsh. Summer was interested learning about the relationship between the periwinkle snail and spartina alterniflora. She spent much of the time in the saltmarsh observing a periwinkle snail crawl toward the top of the cordgrass. After a long observational period, Summer drew a detailed picture and wrote a poem. At the other end of the boardwalk, Kevin observed the barnacles and other life attached to a brick attached to a rope and thrown into the tidal creek. Both students were closely examining relationships between animals as they made their own educational choice. Learning was tailored to their interests as they mastered a high academic standard.

**Interdisciplinary.** As a place-based environmental program, *From Seeds to Shoreline*® is inherently interdisciplinary. It allowed for integration across subjects, rather than teaching subjects in isolation. Dakota described the day at the saltmarsh as "one big learning day." He noted learning experiences incorporated reading, writing, social studies, math, and science "we just walked from the dock, to the marsh, then to the place where we dissected the squid." He compared the natural movement from one learning location to another, it represented the way content knowledge wove together throughout the salt marsh.

**Problem-based learning.** *From Seeds to Shoreline*® lessons helped students apply the core content they acquired. Students naturally followed the scientific model as they asked questions, made predictions, and collected data to make sense of problems within the student lab, school garden, and the saltmarsh. Students grappled with what plants would grow best in our garden, and ultimately, to determine why the *Spartina alterniflora* failed to thrive.

**Constructivist.** Working in the outdoor lab, school garden, and local saltmarsh were examples of authentic, or real-world learning. It was within the outdoor context that learners constructed knowledge for themselves.

## Major Findings

The findings from this action research study emphasize the feasibility of place-based education as an approach to STEM education. The *From Seeds to Shoreline®* environmental program indicated positive change in increasing student motivation and engagement, and improving academic achievement in science.

Cultural Response Pedagogy requires educators to examine societal stereotypes and educational structures that challenge some students to meet with motivational and academic success in learning science (Howard, 2014). Self-Determination Theory (SDT) suggests certain motivational needs and experiences are universally desired (Williams et al, 2018). All students, including students from minority and low-income backgrounds deserve access to high-quality, rigorous, integrated, problem-based, authentic learning experiences. This action research study highlighted the importance of student perception of competence, relatedness, autonomy, and engagement in which learning within the context of a place-based educational program has the potential to increase their motivation to learn science and academic achievement (Skinner & Chi, 2012).

## Practice Recommendations

Place-based education may appear incompatible with standards driven curriculum and structure imposed on schools and students. Educators recognize a “one size fits all” approach to curriculum and pedagogy that “teaches to the test” is a response to a push for measurable outcomes and accountability (Jennings, Swidler & Koliba, 2005). When the curriculum is standardized, the context of place is often disregarded (Gruenewald, 2003a). However, there is evidence of growing interest in place-based education (Vander Ark, 2016). Building on the findings of this action research study may encourage the innovative instructional practices combining instructional curricula design with a network of place-based teaching experts. The school district represented in this study is well positioned to lead in the transformation of meeting the learning needs of all students by utilizing place-based educational instruction. The school district has the opportunity to impact students who are least effectively served by existing educational programs and curricula.

## Action Plan

Research findings from this action research study indicate place-based learning, specifically, *From Seeds to Shoreline*®, may encourage students to become motivated to learn science concepts. The research findings are helpful to better understand student competence, relatedness, autonomy, and engagement in learning through the Self Determination Theory (Ryan & Deci, 2000). The data used to measure student academic growth indicated positive student science learning outcomes.

However, research findings have exposed problems that should be further explored in this action plan. Specific policies and procedures are suggested to address some identified problems and the benefits of place-based education. Three interrelated components are suggested to more fully immerse students in relevant and engaging place-based learning. First, educators should focus on innovations that foster student engagement in learning. Not all students come to school with an appreciation for the place in which they live. A recent survey found children play outside only a total of four hours each week (Kennedy, 2018). Kennedy (2018) observed that engagement with outdoor places is low and often correlated with low socio-economic status. Students who lack exposure and access to unique local places, may benefit the most from place-based education (Anderson, 2017). Second, teaching practices are examined, and targeted professional development considered. The final important consideration of place-based education is the potential impact on the community. Because student learning is connected to specific locations in the community, careful planning should be instituted to strengthen the community connection.

**Recommendation 1**

Implement place-based educational programs, such as *From Seeds to Shoreline®* to address the needs of all learners. Student engagement is critical for increasing academic achievement (Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014). Therefore, implementing place-based, educational programs may engage more students, including those who have been marginalized by traditional education systems. Sugg (2015) conducted a study of place-based education at a Title 1 elementary school in rural Appalachia. The principal advocated outdoor learning makes leaders out of students who may struggle in traditional classrooms (Sugg, 2015). Poverty and lack of exposure to outdoor experiences should not limit student learning. The South Carolina low country lends itself to many existing place-based educational programs, and unlimited ideas for learning experiences utilized by individual teachers and schools.

Integrated instruction grounded in a place-based educational framework with Cultural Responsive Pedagogy has the potential to reach more students where they are regardless of academics and culture. Teaching practices informed by student cultural knowledge engages students within racially, culturally, and linguistically diverse schools (Howard, 2012). Place-based education is a potential link for students to think more critically and transform their community (Smith, 2002b). Diverse student experience is reflected in place-based curriculum which is culturally responsive. Place-based education links global awareness to student understanding of similarities and differences within their community.

**Recommendation 2**

Invest in regular professional development to increase teacher interest and knowledge of unique environmental and cultural features. Kelley & Knowles (2016) claimed teachers struggle to make connections across disciplines. Additional barriers to fully implementing place-based education is lack of teacher STEM knowledge (Smith, Trygstad, & Banilower, 2016) combined with lack of training and place-based knowledge. Without high-quality professional development, teachers may be unable or ineffective at utilizing basic components of place-based education, such as inquiry-based, interdisciplinary lessons, structured on a problem-based model. Teachers new to a particular place may not be aware or knowledgeable of features unique to that location. Every student deserves to receive high-quality instruction from experienced, knowledgeable, enthusiastic teachers. Place-based professional development may provide a powerful way for teachers to learn and share their learning. Local resources that should be considered for environmental professional development of staff include: Coastal Discovery Museum, Master Naturalist Association, Port Royal Sound Maritime Center, Mitchelville Freedom Park, Gullah Museum, The Outside Foundation, Deep Well Project, Arts Council, Hunting Island State Park, Audubon Society, Lowcounty Master Gardner Association, Lowcountry Open Land Trust, and local nurseries and garden clubs. Teachers must be empowered and encouraged to become creators of place-based curriculum rather than repeating curriculum developed by others.

**Recommendation 3**

Reconnect the school and community. "The primary value of place-based education lies in the way that it serves to strengthen children's connections to others, and to the regions in which they live" (Smith, 2002b). As clearly explained throughout the action research, place-based education is an approach to learning that connects student learning and the community. Civic learning engages students with issues relevant to their communities and beyond (Melaville, Berg, & Blank, 2006). Students learn to solve authentic, meaningful problems within the context of their lives and the place they live. With place-based education the curriculum is purposefully centered around the unique, local environment. Involvement in the community helps students break through the wall of separation between the classroom and community that Dewey (1938) described. Gruenewald's critical theory claimed when learning is implemented within the context of the community, people become more confident about the capacity to shape their own lives (Gruenewald, 2003b).

Smith (2002b) suggested that place-based education makes students aware of economic and decision-making processes of a community. Place-based education encourages students to work with community partners to strengthen connections. Students who learn about their community connect with neighbors and become aware of local issues. The *From Seeds to Shoreline®* program encourages students to appreciate the importance of over 200,000 acres of salt marsh and the benefits to their community (Bell, Binz, & Morganello, 2016; Beaufort County Comprehensive Plan, 2017). These students are now ambassadors for their area. After a particularly hard rainfall, Laura reminded a teacher, "[Our] county does not flood as much during bad storms like hurricanes because so much of the rain water filters into the marsh." *From Seeds to Shoreline®* and other place-based curricula give students opportunities to develop skills and methods to share their knowledge, appreciation, and insight with the community.

## Implications for Future Research and Practice

The *From Seeds to Shoreline®* action research study was not experimental; therefore, positive outcomes are correlational instead of causal. Future studies comparing student participants in the *From Seeds to Shoreline®* program to similar students who did not participate in the program may provide more definitive results. The action research study presented was limited by three factors: small sample size, time allowed for the intervention and data collection, and class structure which does not allow for complete integration of subjects. The *From Seeds to Shoreline®* program was incorporated over a six-week period for approximately 45 minutes to an hour each day. The sample size was limited to twenty student participants assigned to the teacher-researcher's class.

**Sample size.** This action research study was limited to a small number of participants. Therefore, it prohibits the teacher-researcher from generalizing findings from this study to populations beyond this group of students. A review of *From Seeds to Shoreline®* or any other place-based education program could be expanded to include multiple classes and schools throughout the school district. Future studies would be enhanced by incorporating students throughout the low country and determine how studying place with *From Seeds to Shoreline®* impacts their motivation to learn science and their science achievement. Additionally, a study could be expanded to better understand the effects of socio-economic status on access to place-based education concepts.

**Time.** The action research study and data collection period occurred over a six-week period for 45 minutes each afternoon. It was challenging to administer pre- and post-surveys and tests during this brief instructional period. The lesson plans required ten days of outdoor instruction with two days devoted to a field trips to the nature center and salt marsh. In addition to planning adequate time to learn the content, the field trip was scheduled around optimal transplanting weather, the interval of the tide, and state testing.

**School structure.** The increase of STEM practices, including place-based education models, requires school review their practice of structured blocks of core subject instruction (Fulmer, Tanas, & Weiss, 2018). According to Kelley & Knowles (2016), students may be disinterested in science and math as a result of disjointed learning in isolation. The benefits of real-world application and connecting to cross-cutting concepts through integrated learning may outweigh the reliance on academic disciplines as the primary framework for instruction (Kelley & Knowles, 2016). Measures of student learning could possibly be tied to place-based educational project learning, rather than individual subject tests.

## Conclusion

"Action research is characterized as research done by teachers for themselves" (Mertler, 2014, p. 4). Based on the desire to improve teaching practice, teacher-researchers participate in the cycle of planning, acting, observing, and reflecting. The goal is to improve student learning. The teacher-researcher recognized a problem of practice, developed a plan to study the problem, collected data, and reflected on the findings to decide the next step. The teacher-researcher realized students were not motivated and engaged in learning science. Over the past several years science test scores have declined. Because action researchers are compelled to address a specific problem of practice, they research possible solutions. This action research study sought to determine how to increase student motivation and engagement in learning science, while at the same time boosting science academic outcomes.

Additionally, there was a need for all students to fully engage in learning. Place-based learning offers strategies for (1) increasing student and teacher engagement, (2) improve academic achievement, and (3) positively impact communities. The review of literature in Chapter Two suggested that place-based educational approaches may increase student motivation and achievement in learning science.

The research methodology discussed in Chapters Three and Four measured student interest and motivation to learn science and science test scores. Both quantitative and qualitative data were collected and analyzed. Student interviews provided a context to hear individual student voices as they constructed their own learning using the *From Seeds to Shoreline®* curriculum. The study concluded with an action plan in Chapter Five to describe methods and best practices for incorporating place-based learning.

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# APPENDIX A

## PARENT PERMISSION LETTER

January 30, 2018

To the parents of:

I am conducting a research study as a doctoral candidate through the University of South Carolina at Columbia, and I would like your student to participate. During our science class this school year, I would like your permission to collect data from your student in the form of written reflections, responses, interviews and assessments.

I may use the data that I collect to write an article for a journal in the field of science education or as supporting materials for a presentation that I make at school, state, or national conference. If I do so, I will take extreme care to ensure confidentiality. I will use pseudonyms in my writing/speaking and will not refer to your students, school, or city by name or do anything that might indicate who my participants are.

The purpose of the study is to determine if place-based education which uses inquiry, collaboration, and hands-on activities has a positive impact on science attitudes and achievement. Little work has been done in this area, and your student will be contributing to the body of knowledge about teaching and learning through place-based education. I believe that this is important work and will be helpful to students and to other classroom teachers.

Your student's participation is strictly voluntary, and there will be no penalty if you choose not to have him/her participate.

Sincerely,

Molly Lloyd

HOW DO I GIVE PERMISSION FOR MY CHILD TO PARTICIPATE IN THIS STUDY?

If you agree to have your child participate, you do not need to do anything. If you do NOT agree for your child to participate, please complete the information below and return the form by February 5, 2018.

Student's Name_______________________________________________________

Parent/Guardian Name__________________________________________________

Parent/Guardian Signature___________________________________Date____________

## APPENDIX B
## SCIENCE MOTIVATION AND ENGAGEMENT SURVEY

| Statement | Not at all true | A little bit true | Kind of true | Fairly true | Totall y true |
|---|---|---|---|---|---|
| **Competence** | | | | | |
| I can get good grades in school. | | | | | |
| If I decide to learn something hard, I can. | | | | | |
| I can do well in school if I want to. | | | | | |
| I am good at working outdoors in the lab, garden, and salt marsh. | | | | | |
| I know a lot about gardening and working in the salt marsh. | | | | | |
| I can identify plants and animals in the lab, garden, and salt marsh. | | | | | |
| **Relatedness** | | | | | |
| I feel like a real part of the outdoor lab and garden. | | | | | |
| The outdoor lab, garden, and salt marsh are good places for students like me. | | | | | |
| I feel like a real part of this school. | | | | | |
| This school is a good place for students like me. | | | | | |
| I need to learn a lot in school so I can take charge of my future. | | | | | |
| I feel close to my friends. | | | | | |
| **Autonomy** | | | | | |
| I learn about plants and animals because I enjoy it. | | | | | |
| It’s exciting to see things grow. | | | | | |
| I work in the lab, garden, and salt marsh so I can learn important things. | | | | | |

| Statement | Not at all true | A little bit true | Kind of true | Fairly true | Totall y true |
|---|---|---|---|---|---|
| Our teacher said I had to work in the lab, garden, and salt marsh; otherwise, I probably would not. | | | | | |
| By working in the lab, garden, and salt marsh, we can make the world a better place. | | | | | |
| Doing well in the lab, garden, and salt marsh is important to me. | | | | | |
| **Engagement** | | | | | |
| When we are working outside, I listen carefully to our teacher. | | | | | |
| The outdoor lab, garden, and salt marsh are interesting. | | | | | |
| I work as hard as I can in science. | | | | | |
| My teacher enjoys teaching us science. | | | | | |
| I try to do well in school. | | | | | |
| I look forward to coming to school. | | | | | |

# APPENDIX C

## STUDENT INTERVIEW PROTOCOLS

### Entrance Interview

Thank you for agreeing to be interviewed today. We will get started in just a few minutes but I will explain the process for our interview first. I plan to record our conversation, if I have your permission to do so. (If yes, then begin recording.)

I have prepared a few questions in advance. However, your answers may prompt me to ask follow-up questions. There is no right or wrong answer to any question, so please answer each question truthfully.

**Student Entrance Interview Questions**

1. What do you think you will learn while working in the outdoor lab?
2. Have you ever planted a garden?
3. What are you hoping to learn when we plant our class garden?
4. What are you hoping to learn when we study the salt marsh?
5. Do you think working outside in the Seeds to Shoreline® program will help you be a better science student and learn more science?

### Exit Interview

Thank you for agreeing to be interviewed today. We will get started in just a few minutes but I will explain the process for our interview first. I plan to record our conversation, if I have your permission to do so. (If yes, then begin recording.)

I have prepared a few questions in advance. However, your answers may prompt me to ask follow-up questions. There is no right or wrong answer to any question, so please answer each question truthfully.

**Student Exit Interview Questions**

1. Did you enjoy learning with the Seeds to Shoreline® program in the outdoor lab, the class garden, and the salt marsh?
2. Think about the entire learning process:
   a. What part did you enjoy learning the most?
   b. What did you learn that surprised you?
3. Do you think leaning outdoors is a good option for you?
4. Would you like to learn about other places unique or special to our area?

## APPENDIX D

## PERMISSION TO USE SEEDS TO SHORELINE® CURRICULUM MATERIALS

October 6, 2018

Ms. E.V. Bell
Marine Education Specialist
SC Sea Grant Consortium
ev.bell@scseagrant.org

Dear Ms Bell:

After completing the Seeds to Shoreline® program for teachers two years ago, I eagerly used the program with two classes of students with great success. I also used the curriculum and learning experiences you provided as the basis of my doctoral study of place-based education. I am a doctoral candidate at the University of South Carolina. The title of my dissertation is "Seeds to Shoreline®: A Place-Based Approach to Impacting Student Engagement and Achievement."

I am requesting permission to use and identify the curriculum provided in the 2016-2017 Teacher Manual and current on the Sea Grant Consortium website. The action research I conducted is not a review of Seeds to Shoreline®; rather it is a review, and ultimately recommendation, of an effective method of teaching a place-based education program. Data indicate a positive change in student attitude toward learning science and an increase in science achievement scores collected during a six-week period in the spring. Please find attached a copy of an *almost* completed draft. Of course, I will send a final draft once it is approved by my advisor, Dr. Yasha Becton, and three other USC committee members. Please advise as to how I should cite the program.

Thank you for your consideration.

Kind regards,

Molly Lloyd
melloyd@live.com
704-692-5532

FW: permission to use Seeds to Shoreline

EV Bell <Elizabeth.Bell@scseagrant.org>

Reply|

Fri 10/12, 4:21 PM

You

You replied on 10/15/2018 5:55 PM.

Hi Molly,

Thank you again for reaching out to us. I consulted with our communications department about citations and they suggested the following:

Citation (Reference Section): Bell, Elizabeth, Binz, J., and Morganello, K. (2016). "*From Seeds to Shoreline®*: Engaging Students in Salt Marsh Restoration," teacher manual. S.C. Sea Grant Consortium.

Citation (in text): Bell, Binz, & Morganello, 2016

Also, couple of minor edits:

1) Please use the full name of the program, "*From Seeds to Shoreline®*", since this is the way (formally) we publicize it (even though most people shorten it when speaking ☺)
2) Thank you for including the trademark symbol; from when our communications folks suggested, it looks like you only need to use the trademark the first time you mention "*From Seeds to Shoreline®*" and then you don't have to for the remainder of the text.
3) On pg. 14, you may want to cite your source where you talk about the acreage of salt marsh in South Carolina. 500,000 acres of salt marsh to be a little high (based on my sources), but if you have a scientific article to back this up, I'd be sure to use it. (And, I'm happy to suggest a few sources if need be.)

Thanks, Molly, and congrats on getting close to defending your dissertation!

Would you mind send me a copy of your final manuscript? I would love to read it!

EV