IMPACT OF AN ENVIRONMENT-BASED EDUCATION PROGRAM ON ACADEMIC ACHIEVEMENT

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Impact of an Environment-Based Education Program on Academic Achievement

Dissertation directed by Professor Dick Carpenter

Along the front range of Colorado, a fourth grade environment-based program—School in the Woods—immerses students in the natural environment for an entire school year. Situated on 640 wooded acres, the school utilizes the environment as a context for learning the state mandated educational standards. This research employed an experimental research design to compare academic achievement between a randomly assigned treatment and control group. The data analysis investigated both proximal and distal measures of learning. Repeated-measures mixed factorial ANOVAs were conducted to compare the mean differences between the groups across a range of proximal measures over three grade levels. Multiple regression models were conducted to analyze distal measures of pre and post test scores. Findings from the proximal analysis indicated that the intervention had a positive influence on reading achievement and no significant influence on math or writing achievement. Reading scores improved at a significantly greater rate in the treatment group during the course of the intervention; however, these positive impacts did not persist. The distal analysis indicated that the intervention had a negative influence on reading achievement and no influence on math.
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CHAPTER 1
INTRODUCTION

“I hear and I forget, I see and I remember, I do and I understand.”

-Confucius

The roots of experiential education first appeared in text more than 2000 years ago with this famous quote from the renowned philosopher and teacher, Confucius. Experiential education is the concept that experience is the source of learning and development. It is believed to be intrinsic to us and describes the natural learning process. The prominent educational philosopher John Dewey (1938) took Confucius’s thoughts further and expressed the idea that all genuine education comes through experience. Dewey promoted a “trial and error” approach to learning that involved direct interaction with the subject matter to test out ideas.

Experiential education is growing in popularity as many alternative schools in the United States have turned to a model that emphasizes “learning by doing” (Barr & Parrett, 1997). This approach to education is appealing because it is a fundamental and intuitive form of educational theory (Beard & Wilson, 2006). The philosophy of experiential education is the foundation for a wide spectrum of alternative approaches to teaching and learning (AEE, n.d.). This research explored environment-based education, a specific educational strategy that draws extensively from the tenets of experiential education. Environment-based education is a framework for instruction that focuses on
academic achievement utilizing the environment as the setting for learning (Liebermann & Hoody, 1998).

This research study utilized an experimental design to examine the effect of a fourth grade environment-based education program on student academic achievement across multiple disciplines. The initiative, the School in the Woods, utilizes the surrounding natural environment as the context for teaching and learning. This school is a yearlong immersive program situated in a ponderosa pine forest on 640-acres of land along the Front Range of Colorado. It is a unique model of an alternative approach to education that works within state mandated educational standards.

**Problem Statement**

According to many, education is the most important investment a country can make in its people and its future (Global Partnership for Education, 2014). Decades after the landmark publication of *A Nation at Risk*, many of the notable failings of our educational system remain (United States Department of Education, 2008). For example, the failure of the United States to close the international test-score gap, despite assiduous public assertions, raises questions about the nation’s overall reform strategy (Hanushek, 2012). America spends more money per student than almost any other country in the world and yet it is “running in place,” while other nations are passing it by (United States Department of Education, 2008). This is a substantial problem that needs to be further addressed with scientific research.

Large-scale federal educational policies such as the No Child Left Behind Act of 2001 aimed to improve student achievement through emphasizing accountability (NCLB, 2002). A result of this mandate has been an increased emphasis on core standards and
testing. One problem arises when these “high stakes” tests lead many states, districts, and teachers to limit the instructional strategies employed in classrooms in order to focus on “teaching to the test” (Ives & Obenchain, 2006). Teachers are forced to choose time-efficient and content-heavy delivery models of teaching over instructional models that promote critical thinking, problem solving, and experiential learning. This movement towards memorization-focused didactic learning is counterintuitive to the psychological foundations set forth by many educational experts. Yet, it persists today as the dominant form of teaching (Ives & Obenchain, 2006). John Dewey vehemently argued against this approach to education, as he believed it stifled student creativity and motivation and led to boredom and apathy:

Why is it, in spite of the fact that teaching by pouring in, learning by a passive absorption, are universally condemned, that they are still so entrenched in practice? That education is not an affair of “telling” and being told, but an active and constructive process, is a principle almost as generally violated in practice as conceded in theory. (Dewey, 1938, p. 27)

Instead, Dewey suggested that learning in a constructivist manner where students are the creators of knowledge, rather than the consumers of knowledge.

The accountability and standardization movement is here for the foreseeable future. Although it may be at odds with Dewey and others, one productive result of this undertaking is that educational leaders are now better able to define challenges and difficulties associated with teaching and learning. While the full solutions to the nation’s educational challenges remain elusive, the search for answers has fueled a movement towards exploring new innovative approaches to educational reform. Across the nation, a
number of reform models and instructional strategies are being employed to reorganize and revitalize schools. One particular educational approach that may inform this effort is environment-based education.

**Purpose of Study**

The purpose of this study was to utilize an experimental design to examine the effects of environment-based education on student achievement. Building on the random assignment admission structure of the school, the research employed an experimental methodology to examine academic achievement differences between the “control” group (non-admitted students) and “treatment” group (admitted students) based on the treatment (School in the Woods participation). The data analysis compared student achievement scores on state-mandated tests over a number of years and across a variety of disciplines, including math, reading, and writing.

**Research Question**

Is there a difference in academic achievement over a range of disciplines between students who attended School in the Woods and students who attended traditional elementary schools?

**Significance**

“Education is the most powerful weapon we can use to change the world.”

- Nelson Mandela

According to some governing charters, education is a fundamental human right that promotes individual freedom and yields important developmental benefits (Craissati, Benerjee, King, Lansdown, & Smith, 2007). The topic of education is clearly a significant issue in our society, as a strong educational system is necessary in order to
provide individuals with the requisite skills to compete and thrive in a global economy (Hanushek, 2012). This research aims to contribute to educational theory and enlarge the body of knowledge surrounding the potential efficacy of environment-based education as a way to significantly improve teaching and learning.

Experiential education is a philosophy growing in both prominence and acceptance. A recent ERIC search revealed 384 peer reviewed journal articles over the past decade that contained “experiential education” as a keyword. The ideology provides the underpinnings for a number of different educational strategies that have been employed in a variety of settings (AEE, n.d.). Environment-based education is one of these strategies, and while there has been a good deal of research done in the area of experiential education, there is gap in the research concerning environment-based education. Moreover, the contribution of this study is evident in three domains: research, policy, and practice.

**Contribution to research.** Current research provides the tenets of environment-based education. However, to the author’s knowledge, no studies have been carried out that have utilized a true experimental design to offer conclusions about the impact of this teaching and learning strategy on elementary student achievement across a range of disciplines. This study provides insights and evidence-based conclusions concerning the impacts of environment-based education. This research is noteworthy in its use of a rigorous experimental methodology along with the “gold standard” of research design, random assignment. This is the ideal methodology to investigate this research question as it best measures effectiveness while also exploring causal effects. Many researchers have called for evidenced-based research to evaluate experiential education and have
noted the challenge of confounding variables as a major barrier to the empirical validation (Ewert & Sibthorp, 2009; Glenn, 2000; Ives & Obenchain, 2006).

**Contribution to policy.** Federal, state, and local policy makers are increasingly calling for proof that educational programs result in measurable outcomes. With this call for evidence, educational research must address the instructional needs of students while also quantifying learning. The recent accountability and standardization movement has resulted in dramatic changes to the educational system, and there is a continual need for research that measures the effectiveness of different approaches. Specifically, there is an increasing demand for more credible evaluations to inform policy. The research is of substantial interest to educators, administrators, funding agencies, community members, politicians, and policy makers who are seeking ways to increase the preparedness of students and improve academic achievement using evidence-based research.

**Contribution to practice.** This study provides an opportunity for teachers and school leaders to learn from an innovative approach to education that utilizes the surrounding environment as a context for teaching and learning. This research is of particular interest as the School in the Woods is a well-established program and unique model of a long-term immersive environment-based initiative. This research is meaningful to educators and practitioners as it provides a lens through which to view how the natural environment can be used as a theme to integrate multiple disciplines and achieve state mandated educational standards. Evidence-based research utilizes data to make decisions about how to practice rather than having to rely on anecdotes, opinions, or precedent. The goal of this research was to use such an approach to further understand how environment-based education can contribute to the teaching and learning world.
**Theoretical Framework**

The theoretical framework—environment-based education—in this study is primarily a tool for organizing and communicating ideas about how School in the Woods functions. It provides a structure for thinking about how the school is organized, its overarching goals, pedagogical approach, guiding philosophy, objectives, and curriculum. It offers scaffolding for the research and specifies the mechanism through which learning occurs (Baldwin, Persing, & Magnuson, 2004). The theoretical framework builds a foundation for knowledge and offers logical explanations for relationships observed (Babbie, 2012). It provides for a theory of change and provides a conceptual structure to explain why researchers may expect to see a difference between the treatment and control groups based on attendance at School in the Woods. The practices and principles of environment-based education, which draw significantly from the tenets of experiential education and place-based education, provide the theoretical framework for this research.

**Description of School**

Founded in 1999, The School in the Woods is a fourth grade magnet program that immerses students in a natural setting to inspire critical thinking and encourage direct interaction with living systems. The environment-based school is situated on 640 wooded acres and is dedicated to an academically challenging curriculum that is integrated around the natural environment. The fourth grade program is a yearlong immersive experience. Students attend the school five days a week during regular school hours over the entire school year. The highly immersive component of this school is a unique feature of this program.
The School in the Woods does not charge tuition. There are no additional costs for students to attend the School in the Woods. Furthermore, transportation is provided for all School in the Woods students in a manner consistent with district policy. At the time of the study, the school district did not charge supplementary transportation fees for students to use district transportation for travel to and from the School in the Woods. The district’s goal has always been to prevent income level from being a prohibitive constraint to participation. As such, financial status should have no implications on what type of student applies to School in the Woods.

At the time of the study, the school consisted of three interconnected modular buildings with two classrooms of students and two teachers. The curriculum and the staff at the school have remained consistent since its conception. The lead teacher at the time of the study was an original co-founder of the school.

The typical school day at School in the Woods is similar to most traditional schools in so far as subjects and class periods sort students’ schedules. Students attend classes such as math, English, science, and social studies just as in traditional schools. The curriculum at School in the Woods follows the broader school district’s traditional scope and sequence. However, what distinguishes this school from traditional schools is the fact that a significant part of instructional time is spent outdoors. The surrounding environment provides a “living classroom” where students are encouraged to actively explore. Students spend time outside for at least some part of every school day. Enthusiasm for the outdoors is used as a vehicle to enrich teaching and learning in all areas of the curriculum. Although, School in the Woods involves scientific inquiry, it is not primarily focused on learning about science. The school’s concentration is on using
the surrounding environment as the framework from which students construct their own learning, guided by teachers and administrators. The guiding philosophy and motto at School in the Woods is “learn from the land.”

Another important distinguishing feature at the school is the notion that students are “naturalists.” Students at School in the Woods are not “students” in the traditional sense; they assume the role of “naturalists,” and as such, are experts in natural history. This denotation is rooted in constructivist theory: students are not passive subjects of learning; rather they are active creators of knowledge. This naturalist perspective gives students a role in the educational process and encourages student ownership and accountability for learning.

Some of the activities and practices that differentiate School in the Woods from a traditional school include: student roles, a school-wide campout and overnight ceremony, a natural playground, an immersive spring field project, archery, pond study, solo spots, journaling, fort building, math walks, outdoor lunch, a school garden, and frequent field excursions to local parks and outdoor spaces. Student roles are an extremely important component of School in the Woods. Students are assigned daily roles such as: meteorologist, astronomer, gardener, composter, water monitor, photographer, historian, etc., and this encourages students to take an active role in their education while promoting student engagement.

The School in the Woods is an example of an environment-based education program, as it employs a framework for instruction that focuses on standards-based educational results utilizing the environment as the context for instruction. The school applies the principles of environment-based education by making connections to the real
world and the surrounding environment, challenging naturalists to use problem-solving skills, incorporating constructivist approaches, applying cooperative and independent learning strategies, and integrating the curriculum in order to encourage students to actively apply knowledge through exploration and experience.

**Organization of Dissertation**

The remainder of this proposal is organized thus: Chapter 2 presents a review of the related literature concerning experiential education, place-based education, and environment-based education. Chapter 3 describes the research design and outlines the methodology utilized in the study. Chapter 4 includes an analysis of the data, and Chapter 5 contains a discussion of the findings.
CHAPTER 2

LITERATURE REVIEW

The purpose of this literature review is to define the area of study and establish the theoretical framework. The goal is to synthesize research around the topic while defining key terminology and identifying the field of scholarship. This review utilizes a funnel approach to the literature and starts broadly with foundational research before narrowing to scholarship most closely aligned with the research question.

The chapter opens with the philosophy of experiential education and then transitions to the methodologies and pedagogies of place-based education and environment-based education. Metaphorically speaking, if the theoretical framework for this study were a tree, experiential education would be the roots, place-based education would be the trunk, and environment-based education would be a branch. The tenets and philosophies of experiential education thus provide the foundation for the growth of place-based education and place-based education provides the structure for the development of environment-based education. And subsequently, environment-based education best represents and describes the conditions found in this research setting.

Structurally, this chapter is divided into three sections: experiential education, place-based education, and environment-based education. Each section is divided into subsections to include an introduction, definition, origins, and description. The latter two
sections, place-based education and environment-based education, each conclude with a subsection that reviews research specifically related to outcomes.

**Experiential Education**

This section of the literature review is devoted to experiential education, as this philosophy supports the theoretical framework for this study. Experiential education provides the roots and groundwork for both place-based and environment-based education. As such, a review of literature concerning these pedagogies and practices inevitably starts with experiential education. By way of definition, experiential education may be understood to be:

> Philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities. (AEE, n.d., para. 9)

**Origins of experiential education.** The foundations and underpinnings of experiential education can undoubtedly be traced to the famous educational philosopher, John Dewey. Dewey was a strong proponent for educational reform, and his philosophies are the core of experiential education. In outlining his ideas of progressive education, the pervading theme of experience consistently emerged in Dewey’s work. He advocated that education should be based on the principle of learning through doing and believed that “all genuine education comes about through experience” (1938, p. 7). Dewey established a relationship between doing and understanding that forms the basis of experiential education as it is known today (Itin, 1999).

Dewey’s first contributions to experiential education began in 1896 when he
established the laboratory schools at the University of Chicago (Kolb, 1984). The laboratory schools were staffed with college-trained teachers and devoted to research, experiment, and educational innovation with the goal of revolutionizing the educational system and transforming society into a great democratic community. The establishment of these experimental schools laid the foundation for experiential education and marked the beginnings of the movement.

Another prominent scholar responsible for the origins of experiential education is Jean Piaget. His work is inextricably linked to the underpinnings of experiential education philosophy. Piaget, an evolutionary biologist and psychologist, viewed learning in a manner similar to the manner in which organisms adapt to survive. He viewed intelligence as a biological process and posited that intelligent adaptation occurs as a result of experience in a manner consistent with the process of how adaptation occurs in evolutionary theory. Broadly, Piaget stressed the need for education to be laced with experience.

Piaget was especially known for his work in the area of cognitive development and is responsible for laying many of the foundations for constructivist theory. In accordance with Dewey, Piaget (1964) contended that a child’s ability to understand broad concepts depends upon learning that evolves from direct sensory experience. Piaget believed that children need concrete experiences to help with their acquisition of abstract thoughts (Kraft & Kielsmeier, 1995). To Piaget, cognitive development is a progressive reorganization of mental processes as a result of biological maturation and environmental experience. He believed that learners adapt when they experience discrepancies between what they already know and what they discover in their new
environment. This adaptation that results from experience is the stimulus for learning and provides the roots of experiential education.

**Description of experiential education.** As a philosophy, experiential education is broad and diverse and encompasses a range of methodologies and practices. Experiential education tenets and concepts have been extended to a wide variety of disciplines and applied in numerous fields (AEE, n.d.). One organization that has ordered the ideas and principles of experiential education is the Association of Experiential Education. The purpose of this organization is to expand and develop educators’ capacities to enrich lives through the philosophy and principles of experiential education (AEE, n.d.). For the purposes of this research and literature review, the following principles of experiential education, drawn from the Association of Experiential Education, are used to describe and outline the concept:

- Experiential learning occurs when carefully chosen experiences are supported by reflection, critical analysis, and synthesis.

- Throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative, and constructing meaning.

- The results of the learning are personal and form the basis for future experience and learning.

- The educator's primary roles include setting suitable experiences, posing problems, setting boundaries, supporting learners, insuring physical and emotional safety, and facilitating the learning process.
Experiential learning occurs when carefully chosen experiences are supported by reflection, critical analysis, and synthesis. In 1897, John Dewey published *My Pedagogic Creed* and proclaimed “education must be conceived as a continuing reconstruction of experience” (p. 79). This proclamation remains the central tenant of experiential education 120 years later (Kolb, 2014). Dewey believed that in order for learning to occur, students must be able to place new knowledge and experience along some continuum of their current knowledge and experience. Students must be able to connect new learning to old knowledge and experience in order for information to be assimilated. For Dewey, the only way to fill the gap between the students’ current knowledge and new knowledge is by utilizing direct experience, analysis, and synthesis.

In experiential education philosophy, reflection is one of the most prominent themes. Reflection is crucial, as learning takes place only when individuals critically reflect upon an experience (Dewey, 1938). During the reflective process, participants develop useful insights that can then result in a change of understanding and/or behavior. Meaning is derived and learning drawn out through reflection. Without reflection, experiences become merely activities (Kolb, 1984).

Dewey’s (1938) Model of Experiential Learning depicts learning as a process integrating experiences, concepts, observations, and action. In Dewey’s model, the impulse of experience gives ideas their moving force, while the postponement of immediate action allows time for observation and judgment. It is through this dual process of impulse and judgment that sophisticated, well-developed concepts are internalized. Dewey’s writings were formative in the development of the Experiential Learning Cycle as outlined by Kolb (1984) in *Experiential Learning: Experience as the*
Source of Learning and Development.

Kolb’s (1984) Experiential Learning Cycle extends Dewey’s model and describes the learning process as including four adaptive learning modes: concrete experience, reflective observation, abstract conceptualization, and active experimentation. At the core of the theory lies the principle that knowledge is the product of how a learner grasps and transforms experiences (Kolb, 1984). Experiential learning asks individuals to first detect, depict, or grasp knowledge, and then to follow this with a phase of construction that completes the learning process. This construction involves a transformation of the grasped knowledge into a mental model through experiencing this knowledge. Kolb proposes that optimal learning involves a cycle of experience, reflective observation, abstract conceptualization, and active experimentation. Furthermore, this cycle is iterative, as old learning is assimilated with new learning. This “cycle” of learning is more of a “spiral” that embeds students in a co-evolution of mutually transforming transactions between themselves and the world around them (Kolb, 2014).

Throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative, and constructing meaning. Experiential education fuels student curiosity as it involves discovery, inquiry, induction, and problem solving as the basis for instruction. In experiential education, concepts are discovered by students, not provided by the instructor. The curriculum works to offer models for problem solving and experimenting, rather than serve as a repository of information.

Constructivist learning theories present an epistemological foundation for what practitioners understand is occurring in experiential education (DeLay, 1996). In
constructivism, students work to make meaning out of their experience by adapting and altering the educative event to fit past versions of their worldview (Von Glaserfield, 1995). Individuals construct new knowledge from experience through the processes of accommodation and assimilation (Piaget, 1971). The key to learning lies in the mutual interaction of the processes of accommodation and assimilation as students work to fit new experiences into existing concepts and schemas, where accommodation is the process of reframing one's mental representation of the external world to fit new experiences, and assimilation is the process of incorporating new experiences into one’s already existing framework.

Drawing from its Piaget origins, experiential education philosophy asks students to be responsible for their education and construct meaning throughout the learning process. The experiential education curriculum is structured to require the student to take initiative, pose questions, make decisions, and be accountable for results. The design of the learning experience includes the possibility to learn from natural consequences, mistakes, and successes. In experiential education, students are compelled to take ownership and accountability for learning. In essence, students “hold the keys” to their educational journey.

*The results of the learning are personal and form the basis for future experience and learning.* Experiential education curriculum is devised to deliberately utilize students’ personal experiences as the context for the application of knowledge. This approach to education stimulates engagement as the curriculum is not prescribed and rigid, but flexible and responsive to student needs, interests, and capabilities. Experiential education involves the full attention of each student through direct
interaction with the material. Students experience things firsthand by creating, designing, building, and testing ideas in order to determine their worth. Experiential education strives to make learning individual and relevant to student’s lives. As John Dewey put the matter:

> From the standpoint of the child, the great waste in schools comes from his inability to utilize the experiences he gets outside of the school in any complete and free way within the school itself; while on the other hand, he is unable to apply in daily life what he is learning at school. That is the isolation of the school-its isolation from life. When the child gets into the schoolroom he has to put out his mind a large part of the ideas, interests, and activities that predominate in his home and neighborhood. So the school, being unable to utilize this everyday experience, sets painfully to work, on another tack and by a variety of means, to arouse in the child an interest in school studies. (Dewey, 1980, pp. 76-77)

To counter the common disconnect between schools and student’s lives highlighted by Dewey, experiential education learning tasks involve student’s daily experiences. Hands-on learning opportunities connect academic content to the students’ lives. A guiding principle of experiential education is that learning opportunities are best when they are relevant and occur within an authentic context.

*The educator's primary roles include setting suitable experiences, posing problems, setting boundaries, supporting learners, insuring physical and emotional safety, and facilitating the learning process.* In contrast to the traditional role of a teacher as a transmitter of knowledge, the role of the teacher in experiential education is
seen as that of an active facilitator or orchestrator (Chaille & Britian, 2002). The teacher as the facilitator is responsible for setting up the educational context for learning, but the educational journey is the students’ to take. In experiential education, the teacher also loses the position of external boss or dictator and takes on the role of the leader of group activities (Dewey, 1938). The role of the teacher is not to prescribe direction, but to establish a physically and emotionally safe setting for learning with suitable and appropriate boundaries.

Given this educational model and central principle of experiential education, it serves to mention that teaching within this philosophy is a challenging and demanding position. Teachers have to relinquish the control of learning and accept that they do not have ultimate control over the outcome. Instructors must have the ability to experiment, reflect, and adapt the curriculum according to findings and proceedings. They need to be able to recognize and encourage spontaneous opportunities for learning. Moreover, instructors must have the ability to pose developmentally appropriate challenges and problems. Students must be given the freedom to construct their own knowledge, and teachers must be able to support students in their quest to make meaning.

**Place-Based Education**

Place-based education builds upon the foundation provided by experiential education and puts these ideas to action. Place-based education is a derivative of experiential education that applies the philosophy to practice. In the theoretical framework for this study, place-based education arises from experiential education. The feature that distinguishes place-based education from experiential education is that place-based education establishes the context for teaching and learning. Experiential education
predominately involves process. Place-based education extends experiential education and prescribes an approach to curriculum development that addresses content. For this study, place-based education may be understood as, the process of using the local community as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum (Sobel, 2004).

**Origins of place-based education.** The theoretical foundations of place-based education go back centuries and have been linked to ancient Greek foundations of community and interdependence (Theobald, 1997). More recently, place-based pedagogy can be traced to John Dewey. Dewey believed that learning occurs most naturally when focused on the intersection of people, their local environments, and an authentic purpose. His emphasis on connecting students to their environment and connecting the realities of daily life with curriculum binds the philosophical and contemporary origins of place-based education (Smith, 2002; Sobel, 2004; Theobald, 1997; Woodhouse & Knapp, 2000). Dewey championed the notion that the immediate localities serve as a lens for disciplinary engagement, and a host of modern educational theorists have followed his lead.

Another recognized author that provided some of theoretical underpinnings for place-based education was Aldo Leopold. While Leopold is widely recognized as one of the preeminent American conservationists, he is rarely credited for his influence on educational theory. In the development of place-based education, however, his work is foundational (Woodhouse & Knapp, 2005). In his most famous work, *A Sand County Almanac*, Leopold (1949) makes an assertion that directly speaks to the roots of place-based education when he states, “every farm woodland, in addition to yielding lumber,
fuel, and posts, should provide its owner a liberal education” (p. 73).

Leopold recognized the significance of learning from that which is local. He was formative in the development of the notion that humans have the ability to develop a “sense of place.” In this context, “sense of place” refers to the feeling or perception that a place has a special or unique quality that fosters a sense of authentic human attachment and belonging. It is hypothesized, that if Leopold were alive today, he would be speaking, writing, and teaching about place-based education (Woodhouse & Knapp, 2005).

Paul Theobald’s (1997) book, *Teaching the Commons: Place, Pride, and the Renewal of Community*, extended Leopold’s concept of “place” and provided a historical and theoretical rationale for reclaiming place as a central component to public education. While not specifically using the term “place-based education”, this book was instrumental in setting the stage for the development of the practice and methodology. Theobald (1997) discussed place-conscious classrooms while advocating for “using the immediate locale as the lens for disciplinary engagement in all schools across the country” (p. 137).

David Sobel (2004) built upon Theobald’s work and formally developed the concept of place-based education. In collaboration with The Orion Society, Sobel is officially credited with coining the term “Place-Based Education” in the mid 1990s (Duffin, Powers, & Tremblay, 2004). Sobel (2004) has been instrumental in advancing the concept and is the author of the field-defining book, *Place-Based Education: Connecting Classrooms & Communities*.

**Description of place-based education.** Place-based education is an approach to
teaching and learning that emphasizes real-world learning experiences. The specific goals of place-based education are to increase academic achievement, help students develop stronger ties to their community, enhance students’ appreciation for the natural world, and create a heightened sense of commitment to serving as active, contributing citizens (Sobel, 2004).

Place-based education is applied in many varied and diverse environments and can take several forms. In order to efficiently and concisely organize a description of place-based education, common elements, as outlined by Smith (2002), will be explored. These core elements of place-based education are:

- The surrounding phenomena are foundation for curriculum development.
- An emphasis on students becoming creators of knowledge.
- Students’ questions or concerns play central roles in determining what is studied.
- Teachers as co-learners.
- The walls between community and school buildings crossed frequently.

The surrounding phenomena are foundation for curriculum development.

Place-based education emerges from the particular attributes of a place (Sobel, 2004). The curriculum is specific to the geography, ecology, sociology, politics, and dynamics of the surrounding phenomena. As an educational approach, it immerses students in local heritage, cultures, landscapes, opportunities, and experiences. It uses these as a foundation for the study of language arts, mathematics, social studies, science, and other subjects across the curriculum.

One of the most distinguishing elements of place-based education is that it promotes learning that is rooted in the immediate schoolyard, neighborhood, town, or
community (Sobel, 2004). Consistent with the philosophy of experiential education, place-based education makes use of the places where students live and inducts them into the discourses and practices of school subjects (Smith, 2013). It is a methodological and instructional approach designed to help students learn about their surroundings by capitalizing on their lived experiences (Woodhouse & Knapp, 2000). In this model, community and place are additional “texts” for learning (Smith, 2013).

In the plainest terms, “place” refers to a unique and bounded biophysical and cultural environment (Greenwood, 2013). A “pedagogy of place” refers to a concept that emphasizes the necessary interpenetration of school, community, and environment (Sobel, 2004). Place-based education can work in urban, suburban, or rural setting as long as the surrounding phenomena serve as an origination point for curriculum development and cross-curricular learning (Woodhouse & Knapp, 2000).

An emphasis on students becoming creators of knowledge. An essential quality of place-based education is the belief that students are creators and producers of knowledge, not consumers of knowledge (Smith, 2002). This core component of place-based education draws directly from constructivism and is similar to the thread woven through experiential education. In this approach, students are not blank slates and knowledge cannot be imparted; conversely, students make sense of learning according to their current conceptions. Place-based education draws from Piaget’s (1971) ideas that students fit new information into already existing schematic frameworks built upon earlier experiences of the world. In absence of these frameworks, what teachers say and or what is encountered in textbooks finds no purchase in a student’s mind (Smith, 2013).

Place-based education posits that learning occurs best when students are actively
involved in a process of meaning and knowledge construction. The curriculum in place-based education affords students the opportunity to participate in the creation and construction of their own learning agenda.

*Student’s questions or concerns play central roles in determining what is studied.* A fundamental element of place-based education is that students have an active role in the direction of their education and are encouraged to take ownership of their learning. Students’ interests and motivations play an integral part in shaping the curriculum and outlining what is studied (Sobel, 2004). The goal is to incorporate students into the act of curriculum development so that their everyday experiences become the foundation upon which learning is constructed and they can more easily grasp and understand what they are learning (Smith, 2013). Drawing from experiential education roots, students’ questions and concerns play a central role in determining what is studied. Place-based education supports an open curriculum that is flexible and dynamic according to student interests and questions. This approach to curriculum development provides students with choices to individual pathways of knowledge based on their personal needs, interests, and preferred learning styles (Woodhouse & Knapp, 2000).

*Teachers as co-learners.* In place-based education learning is a reciprocal process. Students learn from teachers and teachers learn from students. Teaching within a place-based model is a shared process of creating a climate that engages students in learning with others. The primary role of the teacher is to utilize the surrounding phenomena to structure course experiences rich in potential learning opportunities (Sobel, 2004).
Once again, pulling from its experiential education roots, place-based educators act as experienced guides, co-learners, and brokers of community resources and learning possibilities. A teacher’s expertise lies not as much in their stored knowledge as in their capacity to help students acquire the skills and dispositions to be effective learners. Teachers are not experts on the stage delivering information to empty vessels; rather, teachers are facilitators and initiators of educational experiences. Teachers must be comfortable with a fluid curriculum.

Place-based education requires schools to reach out and learn from other community members (Smith, 2013). Teachers are not expected to be content experts in all subject areas and must rely on community experts to help deliver curriculum (Sobel, 2004). Teachers are charged with finding creative ways to teach the common subjects of language arts, math, and science by directing students to issues in their communities worth investigating and reporting on (Smith, 2013). In this model, teachers are indeed co-learners as they learn alongside and together with students.

*The walls between community and school buildings crossed frequently.* An important element of place-based education is the interpenetration of school and community. Place-based education strives to make the boundary between schools and communities more permeable to avoid the division between school and life that worried John Dewey in the late 1800’s (Smith, 2013). This unique aspect fundamentally requires the blurring of the lines between the school and community (Sobel, 2004). In place-based education, the surrounding community is an essential part of the classroom. Students are required to have experiences outside the school and teachers are responsible for taking full advantage of local possibilities for curriculum development.
Outcomes associated with place-based education. This portion of the literature review, and similar portions later in the chapter, reports on research concerning the outcomes related to place-based education. This section is organized chronologically in order to systematically review the literature examining the results of specific place-based education initiatives.

In the first study, Lewicki (2000) depicts the development and implementation of a place-based initiative for a small charter high school of 25 students in Wisconsin. The school is an example of an immersive and long-term place-based education program. The curriculum involved 10 days of field studies in local places such as a restored wetland, a river valley, historical archives, and a senior citizen community center. The freshman and sophomore students worked with 60 professionals and community members over the school year, integrating learning into interdisciplinary courses.

The report used data from “pre” and “post” test scores on the Iowa Test of Educational Development to measure learning. The students took the exam in September and June of the same academic year. The student results showed improvement in test scores in each of the seven sections (science, social studies, reading, math, writing, sources of information, and literary skills) of the test. Specifically, the composite score, which incorporated all the subjects, jumped almost three grade levels over the course of the year. For the composite score, the grade level equivalent moved from 9.8 to 12.5. In each section, the positive improvement observed seems to be connected to the place-based education initiative. However, this article only utilized descriptive statistics and thus only provides possible evidence relevant to the positive academic impacts associated with place-based education. The lack of rigorous statistical analysis and small sample
size prevents strong conclusions.

Similarly, Loveland (2003) descriptively profiles five schools that implemented place-based education to foster academic achievement from the states of Alaska, Oregon, Colorado, Nebraska, and California. This study is predominately explanatory and aims to illustrate what place-based programs look like across the country. The only state that included achievement measures was Alaska, the results of which showed signs of increased achievement in mathematics for students attending a place-based school. Specifically, eighth grade students attending place-based schools performed better on statewide mathematics assessment than students attending traditional schools. Additionally, students in Alaska showed improvements in attendance and decreased dropout rates after local subsistence activities and Native culture were tied to the curriculum. Unfortunately, the results from this study rely on descriptive statistics and can only offer possible evidence relevant to the positive outcomes associated with place-based education. The researcher did not apply the necessary statistical analysis to determine if the difference between the groups of students was statistically significant.

Using somewhat stronger methods, Powers (2004) led a program-evaluation team to conduct individual program evaluations with four collaborating programs and to analyze program processes and outcomes across programs. The external evaluation team conducted a cross-program study and analyzed the effects of four place-based education programs on teachers, students, schools, and communities. Data sources included 163 adult interviews (teachers, administrators, program staff, and community members), 85 student interviews, and 41 field observations.

The program evaluators developed evaluation plans for each of the individual
programs based on the goals and expected outcomes outlined by program staff in their logic models and on meeting with program stakeholders. The research was qualitative and relied heavily on semi-structured interviews and focus groups for data. The study exposed strengths found consistently across schools. One strength was that the use of community partners provided teachers and students with diverse viewpoints, access to resources, facilities, and financial support as well as a broader base of skills and knowledge. Another strength that emerged in the evaluations was the high quality of program staff. Specifically, staff from the four programs demonstrated strong skills in process facilitation, teaching, child development, curriculum planning, and meeting management, as well as more tangible skills such as mapping with geographic positioning systems, gardening, naturalist skills, computer use, and forestry practices. A final strength noted in the study was that the sustained intervention provided by these programs' summer institutes increased the likelihood that the program effects were sustained beyond the initial involvement of the sponsoring organization.

The program evaluations also revealed some challenges. The most consistent external constraint cited by the teachers was a lack of time to devote to curricular change in the midst of multiple curricular pressures. Even though the programs touted their offerings as not adding another layer to the curriculum, but rather integrating into it, there was still a learning curve associated with implementing the approach. Another challenge was the level of attention required by the school district to help teachers acquire adequate curriculum planning skills. The evaluators found that implementing place-based education can be challenging and that teachers need proper training and professional development opportunities.
Two salient themes that emerged consistently throughout the qualitative analysis, even though they were not specifically investigated as part of the evaluation design, were (a) the importance of community-based learning for special needs students and (b) the impact of place-based education on student motivation toward learning and engagement in school. Throughout the evaluation process, the respondents noted that special education students performed better during the place-based learning activities. Furthermore, the evaluators found that place-based education increased student engagement and motivation as learning had a purpose and was rooted in the community.

In a similar program evaluation, Duffin, Powers, and Tremblay (2004) utilized a multiple-methods, utilization-focused, participatory evaluation process that included reports and survey results from 338 educator surveys, 721 students surveys, 315 interviews, and focus groups and case studies spanning 55 schools. The researchers used a “dose-response” measurement strategy and inferential statistics to test whether participating in one of the Place-based Education Evaluation Collaborative (PEEC) programs increased the occurrence of intended program outcomes. The slope of the regression line represented the strength of the effect of the program. The results showed positive, statistically significant correlations between the amount of participant exposure to the program and numerous outcomes, such as student engagement, student motivation, educator engagement/personal growth, teachers ability to meet curricular goals, use of local resources for teaching, adult reports of student engagement in learning and academic achievement, and student reports of attachment to place, time spent outdoors, and environmental stewardship behavior. Additionally, survey results suggested that these place-based education programs made a lasting impact on a school's culture.
Fortunately, this article did utilize inferential statistics to build suggestive evidence relevant to the positive outcomes associated with place-based education.

In Alaska, Emekauwa (2004) performed a study that assessed the impact of a large-scale place-based education initiative. The Alaska Rural Systemic Initiative (AKRSI) was a ten-year rural school improvement effort that utilized a place-based approach to education to develop the untapped potential of indigenous knowledge systems as a foundation for rural/Native education. The study expands upon the work of Loveland (2003), who also examined this initiative. The AKRSI initiative involved 18,982 students in over 176 schools in 20 different school districts. The sample included nearly 60% of the rural student population and 90% of the rural Alaska Native students. In the analysis, the research compared AKRSI students to a group of 28 non-AKRSI schools on measures of math achievement, dropout rates, and college entrance rates.

A comparison of descriptive statistics between AKRSI students and non-AKRSI students revealed that AKRSI students outperformed non-AKRSI students in mathematics, exhibited a lower dropout rate, and enrolled in college at a higher rate. In regards to math scores, the research looked at changes in performance on state mandated assessments and found positive results. In 1995, in the first year of the initiative, only 17.4% of eighth graders in the AKRSI schools scored in the top quartile, compared to 29.1% of students in non-AKRSI rural schools. By 1998, three years later, the gap between AKRSI and non-AKRSI rural schools narrowed from 11.7 percentage points to 5.8 percentage points. In regard to dropout rates, AKSI schools saw a decrease from a mean of 4.4% in 1995 to 3.6% in 2000. In reference to college entrance rates, the report collected data on first time freshman enrollment at the University of Alaska and found
that the number of first-time students from AKRSI districts increased dramatically in the course of this study and eventually surpassed enrollment from non-AKRSI schools. From 1995-2001, the number of AKRSI students enrolling at the University of Alaska increased 49%, from 114 to 170 students. While these numbers paint a positive picture of this place-based education initiative, the lack of rigorous statistical analysis and reliance on descriptive statistics leads to only possible evidence. Fortunately, the study offers a large sample size and what appear to be dramatic improvements in measured outcomes.

In Louisiana, Emekauwa (2004) assessed the impact of a large-scale place-based education initiative. In 1999-2000, East Feliciana Parish School District began Project Connect, a place-based math and science reform effort aimed at improving poor academic performance. Project Connect began by using the environment as a place-based theme to teaching science; however, it expanded over time to include teaching math, history, social studies, and language arts.

The East Feliciana Parish School District is 80% African American and stressed by high poverty levels, as 85% of the students qualified for free or reduced-price lunch. To support the initiative, 52 different teachers participated in summer trainings on place-based learning. Additionally, teachers received ongoing support from school leaders and saw modeling of place-based units developed for their district. Project Connect was funded by the National Science Foundation and reached approximately 1,800 K-8 students.

The report investigated fourth grade and eighth grade language arts, English, math, science, and social studies scores on Louisiana Educational Assessment Program
from 1998-2002. The analysis compares Project Connect schools’ proficiency rates to the statewide proficiency rates with regard to the percentage of “unsatisfactory” students. Interestingly, both populations of students saw an overall positive improvement in performance on these exams. However, the improvement, while not statistically significant, appeared to be greater in Project Connect schools. The results showed that the percentage of students performing at unsatisfactory levels declined at a greater rate in Project Connect schools than in the state as a whole in language arts, English, math, science, and social studies. For example, the percentage of fourth grade Project Connect students receiving a score of unsatisfactory in math declined by 19.1 percentage points from 44% in 1999 to 24.9% in 2002, compared to the statewide decline of 9.9 percentage points from 34.8% to 24.7% during the same time period.

This report documents improvements in statewide assessment test scores over several years for fourth graders in selected schools and districts with place-based education programs. While the results are interesting and raise some provocative questions, the research relies on descriptive statistics to surmise a relationship between place-based education and academic achievement. The report only provides possible evidence, as it does not apply the proper statistical procedures to control for confounding variables and determine a statistically significant difference. However, while this report lacks statistical rigor, it benefits from having a large sample size and hints at possible positive impacts associated with place-based education on academic achievement in a poor performing, low SES school district.

investigation into the relationship between a place-based education program and student academic achievement in the Gorham School District. The initiative evaluated in this report implemented place-based education with the goal of enhancing academic achievement, strengthening community vitality, promoting appreciation for the natural world, and increasing citizenship among students.

This study compared longitudinal trends in standardized test performance in the Gorham School District, before and after the introduction of Community-based School Environmental Education (CO-SEED). The analysis compared CO-SEED scores to statewide averages. Test scores from the New Hampshire Educational Improvement and Assessment Program were used for the analysis. The results showed an increase in student achievement for students that participated in the CO-SEED place-based education program. Specifically, math scores for CO-SEED students increased by an average of 12 points from third grade to sixth grade, while state math scores decreased by an average of four points. Furthermore, for Gorham elementary students who participated in CO-SEED, language arts scores increased by 16% from third grade to sixth grade, compared to only a 2% increase in state scores during the same time period. However, once again, in a manner consistent with many of the other reports in this literature review, the weakness of this report is the lack of rigorous statistical analysis. The results, while positive, rely on descriptive statistics and only offer possible evidence in support of the positive impacts of place-based education.

**Environment-Based Education**

Environment-based education is a further extension of place-based education that also draws significantly from experiential education roots and philosophical
underpinnings. Environment-based education is a more focused branch of place-based education. The feature that distinguishes environment-based education from place-based education is that environment-based education specifically defines the natural environment as the unifying context for teaching and learning. Place-based education more generally outlines the broader “community” as the context for learning; environment-based education narrows this and specifies the natural environment as the context. Another distinction is that environment-based education explicitly targets state-mandated educational standards. In this research setting, environment-based education best represents and describes the practices of the school examined. Environment based education may be understood as a framework for instruction that focuses on standards-based educational results by using the natural environment as a context for instruction (Liebermann & Hoody, 1998).

Origins of environment-based education. The history of environment-based education parallels that of place-based education. Environment-based education shares similar experiential education foundations and these have been outlined in a previous section. Moving forward, the official launch of environment-based education started in 1997 when The Pew Charitable Trusts funded a study to examine opportunities for integrating national and state-level educational standards and the environment (Liebermann, 2013). Based on the results of this study, the State Education and Environment Roundtable was established in 1998. This cooperative endeavor of 12 states’ departments of education is responsible for coining the term “environment-based education” (Liebermann & Hoody, 1998).

Description of environment-based education. An account of environment-based
education must first start with what it is not. Environment-based education is not environmental education. Environmental education refers to the process of teaching children how to learn about and investigate their environment in order to make intelligent, informed decisions with regards to how to take care of it (NAAEE, n.d.). Environmental education is concerned with environmental literacy and is focused on building a base of environmental knowledge and skill to be applied to stewardship. In contrast, environment-based education is concerned with utilizing the environment as a context for all subjects. Environment-based education is focused on using the environment to improve academic achievement and create a wider learning context for student, teachers, and community (Liebermann, 2013).

Environment-based education takes place-based education a step farther, as it is a more specific methodology explicitly oriented towards the natural environment, student achievement, and educational standards. Environment-based education is designed to help students become proficient with national, state, and school district standards. Instructional materials and curriculum are designed specifically for the purpose of helping students master standards-based content (Liebermann, 2013). The curriculum functions as an integral part of a school's standards-based academic program and is used to teach language arts, math, science, history, social studies, and other disciplines. Environment-based education is intended to be employed at either the school or district level with grade-level teaching teams working together to design instructional units that integrate content in several disciplines (Liebermann, 2013).

The State Environmental Education Roundtable (2000) developed a strategy for implementing environment-based education and highlighted key instructional practices.
In order to systematically describe and portray environment-based education, the following themes and practices will be explored:

- Local natural and community surroundings serve as context for learning.
- Community-based investigations and service learning.
- Integrated-interdisciplinary instruction.
- Learner-centered, constructivist approaches.
- Collaborative instruction.
- Cooperative and independent learning.

**Local natural and community surroundings serve as context for learning.**

Environment-based education uses the school’s natural environment as a framework for students to construct their own learning, guided by teachers and administrators (Lieberman & Hoody, 1998). The local outdoor environment provides the context for standards-based instruction and learning. Environment-based schools integrate and connect what students are learning with the surroundings in which they play, learn, and live. Learning is contextualized through the use of local lived experiences in the natural environment. Context is of paramount importance in environment-based education, as knowledge is created and made more meaningful by the context in which it is acquired (Lieberman, 2013). This approach to education provides an authentic real-world context for learning. Furthermore, it incorporates the community’s characteristics into the curriculum and offers students a genuine context to apply their skills and conceptualize learning.

The outdoor environment provides a natural setting replete with authentic and meaningful contexts for learning. It offers a genuine and dynamic framework for
educators to tie together learning across multiple disciplines (Liebermann, 2013). The natural environment is connected and related to science, history, social studies, literature, mathematics, and other studies. Environment-based education is by necessity adaptable to local phenomena and contexts. In contrast to the objectives and directions of the current educational movement, which emphasize prescribed curriculums, environment-based education offers a flexible curriculum adaptable to local environments (Liebermann, 2013).

**Community-based investigations and service learning.** Community-based investigations are an essential component of the environment-based curriculum. Students are encouraged to explore and investigate phenomena in their local environment in order to apply skills and knowledge. In environment-based education, community investigations provide a launching point for educational discoveries. Drawing from place-based education foundation, students are encouraged to work together to wonder, question, explore, research, and evaluate their natural environment. The curriculum is designed to prompt students to investigate the natural world around them. This approach to learning holds great appeal for students as it connects with their innate interests and abilities (Liebermann & Hoody, 1998).

Environment-based education emboldens students to tackle more complex community-based projects, with the intent of resolving authentic problems (Liebermann & Hoody, 1998). The belief is that when students can work through realistic problems in the context of their local environment they can begin to put together the pieces of the puzzle rather than just look at the individual parts through the separate lenses provided by individual disciplines (Liebermann, 2013). Environment-based education encourages the
use of higher-level thinking and creative problem-solving skills toward issues involving
the interaction of their community with diverse cultural, economic, and political
perspectives (Liebermann & Hoody, 1998).

Service learning is a teaching and learning strategy that integrates meaningful
community service with instruction and reflection to enrich the learning experience, teach
civic responsibility, and strengthen communities (CNCS, n.d.). Service learning is an
important component of environment-based education as it provides experiences that
emphasize both civic responsibility and hands-on learning. Environment-based education
values community relationships and utilizes service-learning opportunities to strengthen
communities. Students are encouraged to reflect on their service experiences and
communicate their findings to classmates, teachers, and other appropriate audiences both
inside and outside of their classroom. Furthermore, service learning appeals to a variety
of learning styles and employs students’ cognitive, kinesthetic, affective, and sensory
abilities (Liebermann & Hoody, 1998).

**Integrated-interdisciplinary instruction.** One explicit goal of environment-based
education is to breakdown the traditional boundaries between disciplines (Liebermann &
Hoody, 1998). Integrated, interdisciplinary instruction and academic content work
together to provide support for one another. Skills related to one subject area are
simultaneously strengthened when they facilitate learning in another subject area
(Dickinson & Young, 1998). Instead of compartmentalizing education into subject areas,
the objective of environment-based education is to weave individual learning objectives
into a single instructional tapestry (Liebermann & Hoody, 1998). This movement
towards integrating disciplines draws from the foundations of experiential education and
tenants of place-based education previously outlined. In *How We Think*, John Dewey (1910), called on teachers:

> to engage their students in “constructive occupations” or “projects” that engage students’ interest, have intrinsic worth, awaken curiosity, and are carried out over an extended period of time. These projects should integrate as many of the basic subjects taught in schools as possible. (pp. 216-217)

Environment-based education puts these words into action as it integrates disciplines and instruction.

In environment-based education, the focus is on providing students with a well-rounded and comprehensive view of the world around them. In order to accomplish this objective, the conventional boundaries between subject area disciplines are blurred as students and teachers work across disciplines to achieve educational goals. Environment-based education is intentional in its design to coordinate students' learning between subject areas while building a comprehensive understanding of natural and social systems (Liebermann & Hoody, 1998). Teachers from separate disciplines team together to coordinate learning and explore the connections between disciplines. The goal is for students to begin to recognize how apparently unrelated elements in their natural and social environments fit and work together (Liebermann, 2013).

**Learner-centered, constructivist approaches.** A learner-centered approach in this context refers to methods of teaching that shift the focus of instruction from the teacher to the student. Environment-based education aspires to develop learner autonomy and independence by putting the responsibility for learning in the hands of students. A learner-centered methodology gives students the opportunity to chart their own courses of
study and thus become active participants in their learning (Liebermann & Hoody, 1998). In this form of self-directed learning, students are given the freedom to pursue issues of personal interest and have a role in forming and defining their own specific learning goals and objectives.

A distinguishing instructional practice within environment-based education is the emphasis on adapting teaching and learning to the individual needs and unique abilities of specific students (Liebermann & Hoody, 1998). Environment-based education curriculum attempts to take into account students' individual learning styles, multiple intelligences, and cultural background. This ensures effective instructional design and practices in the context of the local environment.

In a manner similar to both experiential education and place-based education, constructivism is a central concept in environment-based education. The constructivism thread is woven through each section of this literature review and has been previously outlined. The perspective that students are producers of knowledge, rather than consumers of knowledge, is a consistent theme present in environment-based education.

**Collaborative instruction.** Collaborative instruction is a practice used within environment-based education to connect teachers, parents, students, and community members together with regards to instruction and learning (Liebermann & Hoody, 1998). Collaborative teaching typically involves the teaming of teachers from several different disciplines such as language arts, history, math, science, and social studies. These teaching teams can often also include subject area specialists from the community, local businesses, government agencies, and nature centers (Liebermann & Hoody, 1998). Drawing from place-based education, this collaborative strategy helps teachers fill gaps
in their own technical expertise.

Planning sessions are a vital component of environment-based education as multiple teachers are responsible for planning curriculum planning and delivering instruction (Liebermann & Hoody, 1998). Collaborative instruction requires educators to work together to arrange field trips, develop lesson plans, manage schedules, and develop student assessment methods. Planning sessions provide teachers a venue for discussion and communication. These meetings provide educators the opportunity to improve their educational effectiveness and get both professional and personal support from their colleagues. Furthermore, collaborative instruction also promotes student success as teachers working together in partnership with a common group of students have the opportunity to get to know the students better and build a network of support.

Another benefit of a collaborative approach to instruction is that it provides students with additional insights into an issue from a multitude of perspectives and discipline-specific viewpoints (Liebermann & Hoody, 1998). Presenting several diverse perspectives on an issue can help students better understand concepts holistically.

**Cooperative and independent learning.** Environment-based education works to combine elements of both cooperative learning and independent learning in order to promote collaboration among students while also giving individual students time and space to maximize their own potential (Liebermann & Hoody, 1998). Cooperative learning can involve groups of two to three students or the entire class. In this setting, students have the opportunity to learn from the knowledge and experience of classmates (Liebermann & Hoody, 1998). As an instructional practice, cooperative learning provides a venue of students to demonstrate their skills to classmates and develop
interpersonal skills. Working in groups offers students the chance to learn from and gain respect for other student’s perspectives (Liebermann & Hoody, 1998). Students in environment-based schools often work in teams toward the common goal of solving problems connected to a real-world community project.

While cooperative learning is an important practice in environment-based, independent learning also plays a significant role. Environment-based education curriculum is designed to support independent learning and encourage the development of intrapersonal skills. This approach to education considers introspection to be an important component of the learning process and strives to provide opportunities for focused concentration and deliberation. Independent learning opportunities provide students the physical and mental space to work individually in order to process and reflect on learning. Drawing from its experiential education roots, reflection plays a vital role in environment-based education and is often tied to independent learning.

**Outcomes associated with environment-based education.** Lieberman and Hoody (1998) produced the most prominent piece of research in the field, which is notable both for its national scope and positive findings related to the educational benefits associated with environment-based education. In 1998, the State Education and Environment Roundtable (SEER), a cooperative endeavor of state education agencies, released findings on the impact of the environment as a tool of greater academic achievement. The report studied 40 elementary, middle, and high schools in California, Colorado, Florida, Iowa, Kentucky, Maryland, Minnesota, New Jersey, Ohio, Oregon, Pennsylvania, Texas, and Washington. Although the programs differed in many ways, they each employed an environment-based approach to education that utilized the
environment as an integrating context for science, math, social studies, and language arts. This report marks the first time the term “environment-based education” appeared in the literature.

Publishing this research was monumental as it laid the foundation for future research exploring how the environment can be used as a context to improve teaching and learning. The publishing of research around this topic really began with the release of this study. The mixed methods report involved site visits to 40 schools; interviews with more than 400 students and 250 teachers/administrators; four different surveys of the educators; and comparative studies of standardized test scores, grade point averages, and attitudinal measures. The sample of schools included 15 elementary schools, 13 middle schools, and 12 high schools. The teacher surveys included site surveys, learning surveys, teaching surveys, and domains surveys. The overall goal of the research was to tell the story of what environment-based education looked like across the nation. A comparative analysis was performed on 14 of the schools and this analysis compared environment-based education students to traditional students with regard to academic achievement, disciplinary actions, attendance, and student attitude measures. This report coined the term, “Environment as an Integrating Context for Learning” (EIC) to operationalize the educational practices of environment-based education.

The results of this report indicated that students learned more effectively within an environment-based context. Students in EIC programs performed better on standardized measures of academic achievement in reading, writing, math, science, and social studies when compared to non-EIC students. Furthermore, students in EIC programs had fewer discipline and classroom management problems. EIC students also
exhibited higher levels of student engagement, greater enthusiasm for learning, and
greater pride and ownership in accomplishments when compared to traditional students.

While this study is prominent in the research field for its breadth and findings, it
only offers possible evidence in support of the positive impacts of environment-based
education as it relies exclusively on descriptive statistics. The report lacks rigor with
regard to statistical procedures and methodology. The analysis does not utilize inferential
statistics to determine if the observed changes in academic performance between the
groups were statistically significant.

An extension of the work of Liebermann and Hoody, SEER (2000) examined
pairs of California schools to determine if there were measurable changes in academic
achievement over a three-year period between EIC students and non-EIC students as
measured by standardized tests. It compared standardized test scores of eight pairs of
matched student groups in EIC settings with eight groups of matched students in
traditional settings. Of the eight paired groups, there were three high school pairs, one
intermediate school pair, and four elementary school pairs. Each pair was compared over
a variety of standardized tests, proficiency test passing rates, and portfolio analyses in
readings, language, writing, math, science, and social science. The results were presented
for each pair in terms of which group did better on each test.

These results showed that environment-based students performed better on
standardized measures of academic achievement in reading, writing, math, science, and
social studies; showed fewer discipline and classroom management problems;
demonstrated increased engagement and enthusiasm for learning; and exhibited greater
student pride and ownership in accomplishments. Specifically, when comparing
standardized measures of academic achievement in reading, writing, math, science, and social studies, the EIC students’ demonstrated higher scores in 77% of the academic assessments analyzed. Furthermore, EIC students had higher scores in 84% of the combined discipline and attendance measures.

Unfortunately, the results relied purely on descriptive statistics and thus only offer possible evidence as to the positive outcomes associated with environment-based education. The report did not control for confounding variables and did not include an accompanying statistical analysis that would determine if the differences in academic achievement between EIC and non-EIC students were statistically significant. Therefore, while the higher scores on standardized tests hint at positive impacts related to environment-based education, the results are merely indicative. The authors address this issue in the report and state that significant differences in data handling and subsequent reporting between research sites, coupled with small sample size, made it impossible to calculate the standard deviations required for statistical analysis of the results.

A report from Glenn (2000) was designed to inform the public and educational community with information concerning the impacts of environment-based education. This was a national study that included seven case studies of programs in Texas, North Carolina, Wisconsin, Minnesota, Kentucky, and Florida. The seven case studies included five schools (four elementary, one high school), a statewide program, and an environmental center, all of which had adopted environment-based education as the central focus of their academic programs.

The seven programs in the report showed improved scores on reading and math assessment tests, better performance in science and social studies, and declines in
discipline problems. The case studies each varied according to measures of assessment and analysis. Some case studies compared ACT scores to state and national averages, while some compared scores on statewide assessments from year to year. Unfortunately, the report relies only on descriptive statistics and loose comparisons. The report applies the proper statistical analysis to determine if the changes observed were statistically significant. So, while this study is interesting, it only provides possible evidence as to the positive outcomes associated with environment-based. More rigorous statistical analysis is necessary in order to make meaningful conclusions about the effects of environment-based learning on student achievement.

In Hawaii, Volk and Cheak (2003) investigated an inquiry-based environmental education program, called Investigating and Evaluating Environmental Issues and Actions (IEEIA), in a public elementary school with fifth and sixth grade students using qualitative and quantitative methods. While not explicitly environment-based education, the IEEIA curriculum is akin to environment-based education as the environment was used as an umbrella for all content areas within the school. The quasi-experimental study compared 38 IEEIA students and 28 non-IEEIA students on two assessments utilizing an analysis of covariance (ANCOVA) model and $t$-tests. The assessment measures included the Critical Thinking Test of Environmental Education (CTTEE) and the Middle School Environmental Literacy Inventory (MSELI) assessment.

The results showed that students in the IEEIA program scored higher on both the critical thinking test and the environmental literacy test than the non-IEEIA students. The analysis showed a statistically significant difference between the treatment group (IEEIA students) and the comparison group (non-IEEIA students) on both measures. On
the CTTEE, the average score for students enrolled in the IEEIA classroom \((n = 38)\) was 14.18; the average score for non-IEEIA students \((n = 28)\) was 10.86. The \(t\)-test comparison between the two groups indicated that the IEEIA students significantly outscored the non-IEEIA students on the critical thinking skills measured by this test. On the MSELI, \(t\)-test comparisons of the means for the various literacy components indicated that the IEEIA students outscored the non-IEEIA students on five of the eight subtests. These differences were significant for the subtests which attempted to measure Knowledge of Issues (2.84 vs. 1.24), Ecological Foundations (10.55 vs. 7.86), and Issue Analysis (9.24 vs. 4.32). Although IEEIA students outscored non-IEEIA students on subtests that attempted to measure Action Planning (7.53 vs. 5.68) and Issue Identification (4.21 vs. 3.44), the differences between the means were not significant.

In addition, the qualitative analysis found IEEIA students to be using a wider range of reading materials as well as more difficult and challenging materials. Furthermore, IEEIA students appeared to be more skilled analysts of complex issues, have improved writing skills, and be more motivated learners.

In summary, this peer-reviewed journal article provides statistically significant results that demonstrate positive outcomes associated with using the environment as tool to unify curriculum, build environmental literacy, and develop critical thinking skills. The small sample size of 66 is a limitation of this study; however, the quasi-experimental approach and rigorous methodology enable this research to provide suggestive evidence as to the benefits of environment-based education.

In Florida, Ernst and Monroe (2004) produced one of the more rigorous pieces of research in the field of environment-based education. The assessments in the study
included the Cornell Critical Thinking Test (CCTT) to measure critical thinking and the California Measure of Mental Motivation (CMMM) to measure disposition toward critical thinking. The sample for the study was drawn from 400 Florida high school students spread across 11 schools. The researchers compared students who participated in environment-based programs with students who participated in traditional programs within the same school.

Multiple linear regression was used to determine if students in the environment-based programs performed differently on the CCTT and CMMM than students in traditional instructional programs. After controlling for the variance in scores due to students’ initial critical thinking skill, achievement level, gender, and ethnicity, the explanatory variable, covariates, and interaction terms were tested. The following interactions were tested for each outcome variable before testing the significance of the treatment: treatment by pretest (ninth grade only), treatment by GPA, treatment by gender, and treatment by ethnicity.

The results showed that students participating in the environment-based programs tended to score higher on the CCTT than students in the traditional classrooms. Specifically, ninth grade students in the environment-based programs scored 4.33 points higher on the CCTT than students in the control group, and twelfth grade students in the environment-based programs scored 5.54 points higher on the CCTT than students in the control group. With regard to the CMMM test, there was not a statistically significant difference between the treatment and control groups in the ninth grade students. However, for the twelfth grade students there was a statistically significant difference: the students in the environment-based programs scored 3.96 points higher on the CMMM
test than students in the control group.

Qualitative analysis accompanied the quantitative analysis and consisted of analyzing interview transcripts according to a general process of data reduction and interpretation. Inductive analysis was applied to find themes or patterns. In interviews, teachers indicated that the environment-based programs positively influenced students’ critical thinking, involved open-ended projects, investigated issues, conducted research, empowered students to be responsible for their own learning, and provided opportunities for students to reflect on their learning and connect it to their communities. In summary, the results of the study indicate a positive correlation between participation in an environment-based education program and improved critical thinking skills. These conclusions related to critical thinking skills confirm the findings from Volk and Cheak (2003). The rigorous statistical analysis provides suggestive evidence in support of the claim that environment-based education programs can improve critical thinking skills.

Drawing from same sample of high school students in Florida, Athman and Monroe (2004) compared achievement motivation between students who participated in environment-based programs with students who attended traditional programs within the same school. The assessment used to measure achievement motivation was the Achievement Motivation Inventory (AMI). This inventory was developed specifically for this study as a non-content-specific, holistic measure of achievement motivation. The authors measured reliability and internal consistency using a Cronbach’s alpha. For the purpose of construct validation, the researchers used a factor analysis with a maximum likelihood extraction method. The validity threat of selection differences was addressed through statistical control for pre-existing differences including initial motivation level,
grade point average, gender, and ethnicity.

Multiple linear regression was used to determine whether students in environment-based programs performed differently on the AMI than students in traditional programs. A factorial analysis of covariance (ANCOVA) was used to examine the influence of the treatment variable. The results showed that students in the environment-based classrooms scored significantly higher in achievement motivation compared to students in the control classrooms. Specifically, for the ninth grade students, the treatment was statistically significant as students in the environment-based programs scored 2.75 points higher on the AMI than ninth grade students in the control group. For the twelfth grade study, the treatment was also statistically significant; however, this was moderated by ethnicity. Interestingly, the interaction term, treatment by ethnicity, was statistically significant. White students in the environment-based programs scored 8.56 points higher than white students in the control group, the treatment effect was not statistically significant for non-white twelfth grade students. These results suggest that environment-based education may impact students differently based on ethnicity.

Qualitative analysis accompanied the quantitative analysis and showed that students and teachers attributed these positive outcomes to the use of the local environment, the application of learning to real-life issues, and the ability to tailor learning experiences to students’ interests and strengths. Overall, the article provides another layer of suggestive evidence that environment-based programs positively impact students. This article applied a rigorous analysis and found that environment-based education had a statistically significant positive effect on students' achievement motivation.
In South Carolina, Falco (2004) completed a study that included an evaluation of 10 middle schools. The schools utilized an educational approach titled “Environment as an Integrating Concept” (EIC) that is rooted in the tenets of environment-based education. The sample of the report included 1,450 students, 10 schools, and 85 teachers in South Carolina.

In a limited review of descriptive statistics the results imply positive outcomes associated with environment-based education with regard to student attendance, behavior, and academic achievement in all 10 schools. Unfortunately, in reference to academic achievement, only partial data were made available, and the information presented was scattered. However, it was reported that in one school 64% of the seventh grade EIC students achieved a 3.0 grade point average compared with the same group of students as sixth graders where only 28% had a 3.0 grade point average. The results of this study are promising, and the sample size of 1,400 middle school students is encouraging. However, due to a lack of rigorous statistical analysis, the report only provides possible evidence that environment-based education may have positive impacts on academic achievement and motivation.

In Maryland, Von Secker (2004) conducted a program evaluation that included an evaluation of five schools (three elementary and two middle) from 2000 to 2003 that adopted the EIC rooted in the tenets of environment-based education. In this setting, the Chesapeake Bay was used as the integrating concept. The analysis includes student and teacher surveys that were compared using a one-way analysis of variance (ANOVA) to evaluate the extent to which mean scores of groups of students or teachers were statistically significantly different from one another. For comparison’s sake, the students
were statistically divided into three groups according to the intensity of their EIC experiences (low, average, high).

The findings from the Bay Schools Project showed that students in classrooms with a greater emphasis on EIC exhibited higher levels engagement in learning as well as increased levels of environmental knowledge, attitudes, and stewardship behaviors. In all five schools, students’ environmental knowledge, attitudes, and stewardship behaviors were significantly more positive when their teachers placed greater emphasis on using the Chesapeake Bay as an integrating context for learning. Furthermore, students’ reports of their engagement with learning were significantly more positive when their teachers placed a greater emphasis on the EIC curriculum in each of the schools. The consistency of the observed outcomes being statistically significant at each school, each of which had a different combination of implementation strategies, provides confirmation that inferences about environment-based education program replication are valid and warranted. Fortunately, this report does apply the statistical analysis necessary to build suggestive evidence of the positive impacts associated with environment-based education. The report demonstrates that environment-based education can positively influence levels of student engagement and environmental knowledge, attitudes, and stewardship behaviors.

In the second phase of the California Student Assessment Project, SEER (2005) revisited the schools in the original phase to further document the educational efficacy of the environment-based education approaches. The study included an evaluation of four pairs of schools from 1998 to 2002 that adopted the EIC approach that is based on the tenants of environment-based education. The analysis utilized a “paired school”
comparisons methodology to compare the academic achievement of the matched
treatment and control pairs of schools. The results are based on five years of data from
the California’s STAR (Standardized Testing and Reporting) assessment system
representing students in second through fifth grades in reading, math, language, and
spelling. The researchers used the statewide ranking of schools to identify appropriate
control schools for comparison.

This study affirmed the findings in the original phase of the California Student
Assessment Project. This second phase of the research extends the previous work by
introducing methodology that applied statistically significant procedures. The results
showed that students in the environment-based schools scored higher than their
traditionally educated peers on standardized test scores in reading, math, language, and
spelling. Specifically, the researchers analyzed more than 12,700 sets of student data and
found that students in the environment-based programs scored either as well or
significantly higher than control students in 96% of all reading, math, language, and
spelling assessments. In reading, EIC students scored significantly higher than non-EIC
students in 46% of the assessments. In math, EIC students scored significantly higher
than non-EIC students in 49% of the assessments. In language, EIC students scored
significantly higher than non-EIC students in 40% of the assessments. In spelling, EIC
students scored significantly higher than non-EIC students in 33% of the assessments.
Fortunately, the researchers did perform the necessary statistical analysis to determine
that the differences between the treatment and comparison groups were statistically
significant. Thus, this report builds suggestive evidence that demonstrates a positive
relationship between participation in environmental-based education and increased academic achievement.

In Minnesota, Ernst (2005) explored a fifth grade program that utilized a local prairie wetland ecosystem as an integrating context for science, math, and writing. The program was an example of a partnership between the U.S. Fish and Wildlife Service and a local school district. The Prairie Science Class (PSC) employed an environment-based approach to teaching and learning. The sample for the study included a group of 50 fifth grade students in the PSC and a group of 40 fifth grade students in a traditional classroom during the 2003-2004 school year. The program evaluation utilized scores from the Minnesota Comprehensive Assessments (math and writing), affective self-reports, skills self-reports, student interviews, parent surveys, and stakeholder interviews. The data analysis included a range of methods: transcripts from interviews were coded and classified into themes, parent surveys were explored using descriptive statistics, state assessments were analyzed with independent-samples t-tests, skill self reports were examined using dependent samples t-tests, and multiple linear regression was used to analyze the affective self-reports.

The results of the evaluation indicated positive cognitive and affective outcomes in science and writing; perceived learning in math; perceived skill growth in problem solving, technology, and working with others; positive influences on students’ motivation toward learning; and improved attitudes toward the prairie wetlands environment and a stewardship ethic. The quantitative analysis showed that PSC students performed significantly better than traditional students in science and writing but not mathematics. While the self-reports showed a perceived growth in math learning, the analysis of the
state assessment scores does not confirm this. Unfortunately, the lack of an assessment at the beginning of the year prevented the researchers from determining whether the PSC students began with higher achievement levels than their peers in traditional classrooms. So, while this article is beneficial as it provides suggestive evidence as to the positive impact of environment-based education, more rigorous analysis is still necessary to determine causal impacts.

In the state of Washington, Bartosh, Tudor, Ferguson, and Taylor (2006) investigated the impact of integrated environmental education programs on student achievement in math, reading, and writing on the Washington Assessment of Student Learning (WASL). While not explicitly environment-based education, the schools in the study utilized an approach to education that integrated environmental education into their curriculum in a manner similar to environment-based education. For the statistical analysis, two groups were selected; one group consisted of schools that had integrated environmental programs, and one group consisted of traditional schools for comparison. Seventy-seven pairs of schools were selected for the study, and scores from the WASL were analyzed and compared. To match the pairs, the researchers chose schools with well-developed environmental education programs and matched them with corresponding comparison schools that had implemented a traditional curriculum. Paired samples t-tests were used to determine whether there was a statistically significant difference between the two groups. Additionally, a longitudinal analysis was conducted to identify trends in student achievement on the standardized tests in math, reading, writing, and listening.

The results indicated that schools with integrated environmental education programs consistently outperformed traditional schools on the state mandated
standardized assessments. Specifically, the findings revealed a statistically significant difference between the treatment and control groups in math, reading, writing, and listening on the WASL tests. The results showed that in 73 of 77 pairs, environmental schools had higher scores in at least one subject. Furthermore, the longitudinal analysis revealed that the environmental schools had a higher mean percentage of students who met the standards on the WASL for the period 1997-2002. This research provides suggestive evidence towards positive outcomes associated with environment-based education. Going forward, the authors close the article with a call for stronger research methodologies that would allow for more sound claims of evidence and demonstrate a cause-effect relationship.

Conclusion

One clear deduction from this review is the need for more rigorous research concerning the impacts of environment-based education on student achievement. There is a dearth of research applying scientifically based research standards to environment-based education. A discernable gap exists in the research and there is a need for scholarship that employs more rigorous methodology. If this field is going to move forward with substantiated evidence, scientific research utilizing experimental designs along with random assignment is necessary to deduce causal relationships.
CHAPTER 3

METHODOLOGY

This chapter describes the design and specific procedures employed in this dissertation. For organizational purposes, the chapter is ordered into the following sections: research design, setting, sample, instrumentation, data collection, data analysis, assumptions, and limitations.

Research Design

An experimental research methodology employing random assignment was utilized to compare academic achievement between students who attended School in the Woods and students who attended traditional elementary schools. This specific method was chosen for its rigor and its ability to best address the research question. An experimental design enables the investigation of cause-and-effect relationships by exposing an experimental group to a treatment and comparing the results to a control group not receiving the treatment (Isaac & Michael, 1995).

The admission structure of School in the Woods places it in a unique position for determining its efficacy as it generates a natural experiment. This program is a “magnet” school open to all fourth grade students in the school district. It is an educational choice program, and all students within the district are eligible to apply for admission without regard to the geographic location of their residence. The district utilizes a lottery system that employs random assignment to determine which students are admitted to the school.
and which students are not admitted. The school district employs this procedure for its objective nature and its ability to ensure equitable access. Each student who applies to the school has an equal chance of being accepted. This process produces a natural experiment, as students are randomly assigned to either a treatment group or a control group.

Setting

The mission of the school district is to educate every student in a safe and nurturing environment and to provide comprehensive, challenging curricular and extracurricular opportunities that meet the unique needs of every individual by expanding interests, enhancing abilities, and equipping every student with the knowledge, skills, and character essential to being a responsible citizen of our community, our nation, and the world.

The sample for this study arose from the fourth grade population of students in the school district. Demographic data for the sample were not available; however, descriptive statistics for the fourth grade population, school district, and state are presented below in Table 1. In regard to ethnicity, the fourth grade population of students in the district was predominately white. Specifically, 79% of the fourth grade students in the population were white. In contrast, the statewide percentage of white students was 57%. Table 1 further disaggregates the ethnicity of the population and state in greater detail.
Table 1

*Ethnicity of Students in School District and Colorado*

<table>
<thead>
<tr>
<th></th>
<th>White</th>
<th>Hispanic</th>
<th>Asian</th>
<th>Black</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>District Fourth Grade Population</td>
<td>79.0%</td>
<td>9.5%</td>
<td>5.7%</td>
<td>5.1%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Colorado Statewide</td>
<td>56.8%</td>
<td>31.6%</td>
<td>2.9%</td>
<td>4.8%</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

In regard to socio-economic status, the school district within which the program was housed was relatively affluent. Only 10.4% of students were eligible for either “reduced lunch” or “free lunch.” In sharp contrast, 40.3% of students statewide were eligible for either “reduced lunch” or “free lunch.” Table 2 further disaggregates the socio-economic status of the school district.

Table 2

*Eligibility for Free and/or Reduced Lunch*

<table>
<thead>
<tr>
<th></th>
<th>Not Eligible</th>
<th>Reduced Lunch</th>
<th>Free Lunch</th>
<th>Free &amp; Reduced Lunch</th>
</tr>
</thead>
<tbody>
<tr>
<td>School District</td>
<td>89.4%</td>
<td>3.3%</td>
<td>7.1%</td>
<td>10.4%</td>
</tr>
<tr>
<td>Colorado Statewide</td>
<td>59.4%</td>
<td>6.9%</td>
<td>33.4%</td>
<td>40.3%</td>
</tr>
</tbody>
</table>

In regard to academic achievement, the fourth grade population within the school district was high achieving when compared to statewide averages. For instance, 84% of the fourth graders in the school district were either “advanced” or “proficient” in reading, as compared to 66% of students statewide. Furthermore, 69% of fourth graders in the school district were either “advanced” or “proficient” in writing, as compared to 50% of
students statewide. Lastly, 85% of fourth graders in the school district were either “advanced” or “proficient” in mathematics, as compared to 70% of students statewide. Tables 3, 4, and 5 further describe the academic achievement of the fourth grade population from which the sample was drawn.

Table 3

*Colorado State Assessment Program Reading Achievement*

<table>
<thead>
<tr>
<th></th>
<th>Advanced &amp; Proficient</th>
<th>Advanced Proficient</th>
<th>Partially Proficient</th>
<th>Unsatisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>District</td>
<td>84%</td>
<td>6%</td>
<td>78%</td>
<td>13%</td>
</tr>
<tr>
<td>Fourth Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statewide</td>
<td>66%</td>
<td>3%</td>
<td>62%</td>
<td>23%</td>
</tr>
<tr>
<td>Fourth Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4

*Colorado State Assessment Program Writing Achievement*

<table>
<thead>
<tr>
<th></th>
<th>Advanced &amp; Proficient</th>
<th>Advanced Proficient</th>
<th>Partially Proficient</th>
<th>Unsatisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>District</td>
<td>69%</td>
<td>15%</td>
<td>54%</td>
<td>29%</td>
</tr>
<tr>
<td>Fourth Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statewide</td>
<td>50%</td>
<td>9%</td>
<td>42%</td>
<td>41%</td>
</tr>
<tr>
<td>Fourth Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5

*Colorado State Assessment Program Math Achievement*

<table>
<thead>
<tr>
<th></th>
<th>Advanced &amp; Proficient</th>
<th>Advanced</th>
<th>Proficient</th>
<th>Partially Proficient</th>
<th>Unsatisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>District Fourth Grade Population</td>
<td>85%</td>
<td>41%</td>
<td>44%</td>
<td>12%</td>
<td>3%</td>
</tr>
<tr>
<td>Statewide Fourth Grade</td>
<td>70%</td>
<td>29%</td>
<td>41%</td>
<td>21%</td>
<td>8%</td>
</tr>
</tbody>
</table>

**Sample**

The population for this study consisted of 1,680 fourth graders in a suburban school district in southern Colorado. The School in the Woods is a magnet program that welcomes applications from any interested students in the district. The only criterion for inclusion is that the student be currently enrolled as a third grader within the school district at the time of the application. The sample for this study consisted of 103 students, all of who applied for admission to School in the Woods for the 2009-2010 school year.

In order to apply to School in the Woods, students and families must submit an application during the specified application window. Additionally, the district strongly recommends that families attend an informational meeting about School in the Woods in order to better understand the unique aspects of the program. The informational meeting serves also serves as an open house and occurs on a Saturday in late January. The window for applications opens the first week of January and stays open until the last week of February. No priority is given to early applications. Furthermore, the school
also requires that applications include a signed “School in the Woods Agreement” form that details the immersive nature of the program. This agreement form outlines the commitment required to attend School in the Woods and provides additional information concerning the emphasis on spending time outdoors.

In order to assure fairness in the application process, the district employed a randomized lottery system to admit students. A child’s chance of being admitted to the school depended upon the total number of applicants that applied. Through the lottery process, 44 students were accepted and admitted to School in the Woods (treatment group), and 59 students were not accepted and not admitted to School in the Woods (control group). The control group of students continued to attend their traditional district schools. These 59 students were distributed across 18 different elementary schools throughout the district.

**Instrumentation**

**CSAP.** The Colorado Student Assessment Program (CSAP) was a standards-based assessment designed to provide a picture of student performance to school districts, educators, parents, and the community (CDE, 2010). Since this study, CSAP has been replaced with a different statewide assessment instrument. Consequently, further data could not be added to the study, as subsequent tests differed from CSAP and their use in this study would have introduced an unreliable measure into the design and analysis.

The purpose of the CSAP was to provide an annual measure of student performance relative to the Colorado Model Content Standards in the learning areas of reading, writing, geography, science, history, and mathematics. The intention was that CSAP results were to be utilized by educators and school administrators to improve
curricula and instruction as well as to increase individual student learning (CDE, 2010). This instrument was utilized in this dissertation as it best measured academic achievement with regards to state standards across all students. The objective of School in the Woods is to help students achieve in relation to state standards, and this provided the rationale for utilizing CSAP scores as a dependent variable and proximal measure of learning and academic achievement. Proximal refers to the proximity or distance of the measure to the enactment of the particular curricular activity (Ruiz et. al, 2002).

Educators and community members developed the Colorado Model Content Standards in a two-year process that involved three publicly reviewed drafts, 10,000 responses to these drafts, and regional meetings across the state (CDE, 2010). These standards were objective statements of the academic content each student was expected to learn; they described what students should know and be able to do (CDE, 2010). Content standards focused the educational system on common, well-defined goals. Within Colorado, any philosophy, curriculum, teacher-training program, or class scheduling system was acceptable as long as it demonstrated progress in bringing students up to the standards (CDE, 2010). This philosophy provides the justification for the School in the Woods model, as it uses the environment as a context for teaching and learning Colorado educational standards.

The CSAP assessments were large-scale standardized paper-and-pencil achievement tests administered annually to every public school student in Colorado. All CSAP forms were timed assessments and administered under standardized conditions to ensure the reliability and validity of the test results. All students in grades 3 through 10 for reading/writing and mathematics and grades 5, 8, and 10 for science were tested with
a single form for each grade (CDE, 2010). Assessments were administered towards the end of the school year in late spring. CSAP assessments were administered to all district students during the district-specified testing window. Both SITW and non-SITW students were administered the assessments during the same time period of the school year.

In the CSAP reporting process, students’ total scores were based on their performance on all the scored items on the test. Raw scores were converted to scale scores to allow for a common unit of measurement that was consistent across test administrations and time. The rationale for using scaled scores was to enable comparison within grades and between grades over time (CDE, 2010). In the CSAP, the range of the scaled scores was manipulated and increased from grade to grade to allow students’ growth to be reflected in the subsequent administrations. However, it should be noted that the same range of scaled scores was maintained over the years within each respective grade level to allow for comparisons between grades (CDE, 2010).

CSAP assessments underwent significant testing for validity and reliability and provide accurate and consistent measurements of student achievement. In order to ensure the content related validity of the CSAP assessments, the Colorado Model Content Standards and Assessment Frameworks were studied by content developers, who worked with content-area specialists, teachers, and assessment experts to develop a pool of items that measured Colorado’s Assessment Frameworks in each grade and content area (CDE, 2010). Construct validity, the meaning of test scores and the inferences they support, were the central concepts underlying the CSAP validation process. Evidence for
construct validity was comprehensive and integrated evidence from both content-related and criterion-related validity (CDE, 2010).

Reliability is an index of the consistency of test results. In order to ensure the reliability of the CSAP assessments, a Cronbach’s alpha was calculated to measure internal consistency. At the state level, the total reliability coefficients for content areas ranged from between 0.85 and 0.94, with a median value of 0.93 (CDE, 2010). This reliability coefficient range is indicative of high internal consistency and signified that the CSAP tests produce relatively stable scores. Further procedural information on CSAP validity and reliability is available in the 2010 CSAP Technical Report.

**Scantron.** The Scantron Online Assessment was a district-wide assessment used to inform instruction and assess gaps in individual student achievement. These assessments were administered to all district students in grades 3-10 for both reading and math. The Scantron assessments were administered twice a year, once in the fall and once in the spring. The assessments were administered to all district students during the district specified testing window. Both SITW and non-SITW students were administered the assessments during the time period of the school year.

The Scantron assessments employed by the district were research-based, criterion-referenced computer-adaptive tests. These assessments adapted and adjusted according to each student’s ability. Each test was unique, as questions got easier when students answered incorrectly and questions got more challenging when answered correctly. The results of these assessments were used to let educators quickly pinpoint the instructional level of students across a range of subjects, capture immediate results, and produce reports with suggested learning objectives. This instrument was included in this
dissertation in order to serve as a dependent variable and a distal—as compared to state and curriculum-based assessments—measure of learning and academic achievement. Distal refers to the proximity or distance of the measure that is further away from the enactment of the particular curricular activity (Ruiz et. al, 2002).

The Scantron assessment employed by the school district was the Performance Series. This was a fully integrated computer adaptive diagnostic assessment used to track student growth over time (Scantron, 2009). The Performance Series was aligned with the Common Core State Standards and was designed to enable educators to identify the proficiency levels of students, understand student performance in relation to others, predict summative test results, inform instruction, and help with student placement (Scantron, 2009). The Performance Series tests were not timed and were generally given to students at the beginning of each year as a diagnostic assessment to measure learning levels and guide student placement. These assessments were then administered again in the spring to measure gains. As a note, these subsequent administrations were not “retests” of the content measured in the initial administration.

The Scantron assessments utilized scaled scoring that estimated student ability based on item response theory. Since negative ability estimates were possible, Scantron applied a transformation to make all reported scale scores positive in value. Item-bank statistics, analyses, and procedures used to illustrate and demonstrate the concepts of reliability and validity as they relate to Performance Series were reviewed for completeness and accuracy by a statistical team (Scantron, 2009). Further procedural information on validity and reliability is available in the 2009 Scantron Performance Series Technical Report.
**Data Collection**

Data were provided in electronic format by the district. This served as a convenient and accessible measure of student progress without imposing an additional burden to the district or students. Data were collected through the district assessment coordinator and coded to ensure anonymity. The district assessment coordinator masked student identification and created identifying numbers to label cases for statistical analysis. Approval for the study was obtained from the Institutional Review Board (IRB) at both the University of Colorado Colorado Springs and the school district.

**Data Analysis**

The statistical procedures employed to analyze the data included a mixed factorial ANOVA and multiple linear regression. These analytical techniques best answered the research question and explored both proximal and distal measures of learning. A p-value of 0.05 was utilized to indicate statistical significance.

**Mixed factorial ANOVA.** A repeated-measures mixed factorial ANOVA was conducted to compare the mean differences between the treatment and control group across a range of measures over a range of time. Multiple mixed factorial ANOVAs were conducted using CSAP math, reading, and writing scores as the dependent variables. The three level ANOVA compared the CSAP scores of the treatment and control groups over three time periods (3rd grade, 4th grade, 5th grade). The within-subjects factor was the time of measurement (grade) and the between-subjects factor was the treatment (SITW, non-SITW). Any significant interactions were found to occur in the ANOVA were followed up with a post hoc analysis using a Bonferroni adjustment to determine where the interaction occurred.
The primary purpose of a mixed factorial ANOVA is to understand if there is an interaction between the within-subjects factor and between-subjects factor on the dependent variable. This analysis allowed for the partitioning of variance and enabled the analysis of “between groups variance” and “within groups variance.” The method was appropriate for this experimental design as there were repeated measures of the dependent variable (achievement score) and a between-group independent variable (SITW participation).

**Regression.** Multiple regression was utilized to analyze the Scantron scores. Multiple linear regression modeled the relationship between the independent variables and a dependent variable by fitting a linear equation to observed data. This statistical procedure was appropriate for this analysis as the dependent variables were continuous, and there were multiple independent variables. The Scantron assessments served as measures of “pre” and “post” test scores in this analysis. The fourth grade cohort of students took this assessment in both the fall and spring of their fourth grade year. Two multiple regression models were run in this analysis. One regression model explored math scores, and one regression model explored reading scores. The dependent variable in each analysis was the spring (post) score and the independent variables were group membership (treatment/control) and fall (pre) score. The regression equations took the form:

\[
\text{Spring}_{\text{Reading}} = \beta_0 + \beta_1 (\text{Group}) + \beta_2 (\text{Fall}_{\text{Reading}})
\]

\[
\text{Spring}_{\text{Math}} = \beta_0 + \beta_1 (\text{Group}) + \beta_2 (\text{Fall}_{\text{Math}})
\]

Multiple regression predicted the value of the dependent variable based on the value of multiple independent variables. Specifically, this regression analysis examined
if there was a difference in spring (post) scores based on group membership (SITW/non-SITW) after controlling for fall (pre) scores of the same measure. The multiple regression analysis determined the overall fit (variance explained) of the model.

**Assumptions**

Statistical tests rely upon certain assumptions about the variables used in the analysis. When these assumptions are violated, the results may not be trustworthy and may lead to an incorrect estimation of significance or effect size. A Type I or Type II error may result if any assumptions are violated.

**Mixed factorial ANOVA.** This analysis addressed the assumptions of a mixed factorial ANOVA to ensure that proper statistical procedures were utilized to determine significance and effect size. The first assumption addressed was that the dependent variable in the analysis had a metric measurement level.

The second assumption addressed was normality. In mixed factorial ANOVAs the dependent variable must be approximately normally distributed for each combination of the groups for the within-subjects factor and the between-subjects factor. The data were tested for normality using the Shapiro-Wilk Test of Normality.

The third assumption addressed was homoscedasticity. Mixed factorial ANOVAs require homogeneity of variances for each combination of the groups of the two factors, the within-subjects factor and between-subjects factor. This means that the error variances of all data points of the dependent variable are relatively equal or homogenous throughout the sample. The variability in the measurement error must be constant along the scale and not increase or decrease with larger values. Homoscedasticity was tested with Levene’s Test for Homogeneity of Variances.
The final assumption addressed was sphericity. For the sphericity assumption to be met, the variances of the differences for the within-subjects factor and between-subjects factor must be equal. Mauchly's Test of Sphericity was applied to test this assumption.

**Regression.** This analysis addressed the assumptions of multiple regression to ensure that the proper statistical procedures were utilized to determine significance and effect size. The first assumption addressed was linearity. For multiple regression analysis to be employed, there must be a linear relationship between the dependent variable and the independent variables. Scatterplots were created to visually inspect the data and assess linearity.

The second assumption addressed was normality. Multiple regression requires the residuals (errors) to be approximately normally distributed. In order to test for normality, a histogram and fitted normal curve were produced and assessed.

The third assumption addressed was multicollinearity. Multicollinearity occurs when two or more independent variables are not independent of each other and are in fact highly correlated. This leads to problems with understanding which independent variable contributes to the variance explained in the dependent variable. Multicollinearity was inspected with correlation coefficients, tolerance values, and variance inflation factors.

The fourth assumption addressed was autocorrelation. Autocorrelation occurs when the residuals are not independent from each other. A Durbin-Watson Statistic test was used to determine independence of observations (i.e., independence of residuals).

The fifth assumption addressed was homoscedasticity. Homoscedasticity refers to the error terms along the regression line being roughly equal. A scatterplot was produced
that plotted the studentized residuals against the unstandardized predicted values. The scatterplots were utilized to visually inspect the variances along the line of best fit to assess if they remained similar when moving along the line.

The sixth and final assumption addressed was outliers. In regression analysis, there should not be any significant outliers. Outliers can have a negative effect on the regression equation as they can reduce the predictive accuracy of results as well as the statistical significance. Outliers were examined through casewise diagnostics and studentized deleted residuals to check for influential points using a measure of influence known as Cook's Distance.

**Limitations**

The major weakness of this study is the relatively small sample size. Small sample sizes involve greater sampling errors, lower reliability, and decrease the power of the statistical test applied to the data. Furthermore, a small sample size can make finding significant relationships in data difficult. The specific nature of this dissertation and the research question dictated the parameters of this study and contributed to the small sample size. There was not a practical way to increase the sample size, as the state transitioned away from CSAP and towards a different statewide assessment program in 2012. Moreover, study findings are limited to the students who applied, were admitted, and attended School in the Woods and to the students, who applied, were not admitted, and thus attended their traditional school during the years covered in this study.
CHAPTER 4

RESULTS

This chapter presents the findings of the data analysis conducted to answer the research question. Structurally, the chapter is organized around the three proximal measures and two distal measures of academic achievement. The CSAP instruments (writing, math, and reading) served as proximal measures of learning as they were aligned with the state-mandated standards and district curriculum. The Scantron Performance Series instruments (math and reading) served as distal measures of learning as they were more generally designed to assess proficiency, track growth, help with student placement, and inform instruction.

CSAP – Writing

As a reminder, a mixed factorial ANOVA was conducted to determine the effects of SITW participation, time, and the interaction effect between SITW participation and time on CSAP writing scores. The descriptive statistics in Table 6 demonstrate that writing test scores increased from year to year for both SITW and non-SITW students. In this case, the treatment and control groups started with similar mean writing scores in 3rd grade. However, over the time period of the treatment (4th grade), SITW students’ mean writing scores increased 25.48 points. Alternatively, non-SITW students mean writing score increased 14.11 points over the same time period. This trend is reversed one year
after treatment (5th grade); non-SITW students’ scores increased 36.35 points, and SITW students’ scores increased 18.46 points.

Table 6

*Descriptive Statistics – Colorado State Assessment Program Writing Scores*

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSAP 3rd Grade Writing Score</td>
<td>Non-SITW</td>
<td>59</td>
<td>515.25</td>
<td>42.90</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>516.11</td>
<td>50.77</td>
</tr>
<tr>
<td>CSAP 4th Grade Writing Score</td>
<td>Non-SITW</td>
<td>59</td>
<td>529.36</td>
<td>39.46</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>541.59</td>
<td>51.88</td>
</tr>
<tr>
<td>CSAP 5th Grade Writing Score</td>
<td>Non-SITW</td>
<td>59</td>
<td>565.71</td>
<td>53.53</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>560.05</td>
<td>55.94</td>
</tr>
</tbody>
</table>

The main effect of SITW participation yielded an F ratio of $F(1, 101) = 0.09$, $p=0.768$, $\eta^2_p = .001$, indicating no statistically significant difference between the treatment and control groups with regards to CSAP writing scores. The main effect of time yielded an F ratio of $F(1, 101) = 60.51$, $p<0.001$, $\eta^2_p = .375$, indicating a statistically significant difference between 3rd, 4th, and 5th grade scores with regards to the CSAP writing assessment. The interaction effect between SITW participation and time yielded an F ratio of $F(1, 101) = 2.21$, $p=0.111$, $\eta^2_p = .021$, indicating no statistically significant interaction effect with regards to CSAP writing scores. These ANOVA results indicate that CSAP writing scores increased significantly over time for both groups; however, overall scores for SITW participants did not differ significantly from non-SITW students, and the growth in scores was not significantly different between groups.
A graph of the estimated marginal means for CSAP writing scores is provided in Figure 1 and illustrates how test scores increased over time for both SITW and non-SITW students. The graph illustrates that the slope of the SITW line from 3\textsuperscript{rd} to 4\textsuperscript{th} grade is steeper than the slope of the non-SITW line over the same time period. Descriptively, SITW students writing scores increased at a greater rate during the course of the treatment than non-SITW students writing scores. Conversely, this trend is reversed from 4\textsuperscript{th} to 5\textsuperscript{th} grade when the treatment was removed. The slope of the non-SITW line from 4\textsuperscript{th} to 5\textsuperscript{th} grade is steeper than the slope of the SITW line over the same time period. This indicates that non-SITW students writing scores increased at a greater rate than SITW students a year after the treatment. However, again, these slopes were not statistically significantly different between groups.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure1}
\caption{Estimated Marginal Means of Colorado State Assessment Program (CSAP) Writing Scores for School in the Woods (SITW) and Non-School in the Woods (Non-SITW) Students Over Time.}
\end{figure}
CSAP – Math

As with writing, a mixed factorial ANOVA was conducted to determine the effects of SITW participation, time, and the interaction effect between SITW participation and time on CSAP math scores. The descriptive statistics in Table 7 demonstrate that math test scores increased from year to year for both SITW and non-SITW students. In this instance, the treatment and control groups started with relatively similar mean math scores in 3rd grade. However, over the time period of the treatment (4th grade), SITW students’ mean math scores increased 31.89 points. Alternatively, non-SITW students’ mean math scores increased 13 points over the same time period. This trend is reversed one year after treatment (5th grade); non-SITW students’ scores increased 30.14 points, and SITW students’ scores increased 23.18 points.

Table 7

Descriptive Statistics – Colorado State Assessment Program Math Scores

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSAP 3rd Grade Math Score</td>
<td>Non-SITW</td>
<td>60</td>
<td>543.48</td>
<td>69.83</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>539.59</td>
<td>62.60</td>
</tr>
<tr>
<td>CSAP 4th Grade Math Score</td>
<td>Non-SITW</td>
<td>60</td>
<td>556.48</td>
<td>60.75</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>571.48</td>
<td>42.48</td>
</tr>
<tr>
<td>CSAP 5th Grade Math Score</td>
<td>Non-SITW</td>
<td>60</td>
<td>586.62</td>
<td>59.86</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>594.66</td>
<td>53.57</td>
</tr>
</tbody>
</table>

The main effect of SITW participation yielded an F ratio of $F(1, 102) = 0.39$, $p=0.532$, $\eta^2_p = .004$, indicating no statistically significant difference between the
treatment and control groups with regards to CSAP math scores. The main effect of time yielded an F ratio of $F(1, 102) = 44.67, p<0.001, \eta_p^2 = .400$, indicating a statistically significant difference between 3rd, 4th, and 5th grade scores with regards to the CSAP math assessment. The interaction effect between SITW participation and time yielded an F ratio of $F(1, 102) = 1.69, p=0.188, \eta_p^2 = .016$, indicating no statistically significant interaction effect with regards to CSAP math scores. These ANOVA results indicate that CSAP math scores increased significantly over time for both groups; however, overall scores for SITW participants did not differ significantly from non-SITW students, and the growth in scores was not significantly different between groups.

A graph of the estimated marginal means for CSAP math scores can be seen in Figure 2 and illustrates how test scores increased over time for both SITW and non-SITW students. The graph illustrates that the slope of the SITW line from 3rd to 4th grade is noticeably steeper than the slope of the non-SITW line over the same time period. Descriptively, SITW students’ math scores increased at a greater rate during the course of the treatment than non-SITW students math scores. Conversely, this trend is reversed from 4th to 5th grade when the treatment was removed. The slope of the non-SITW line from 4th to 5th grade is slightly steeper than the slope of the SITW line over the same time period. This indicates that non-SITW students math scores increased at a slightly greater rate than SITW students’ a year after the treatment.
Figure 2. Estimated Marginal Means of Colorado State Assessment Program (CSAP) Math Scores for School in the Woods (SITW) and Non-School in the Woods (Non-SITW) Students Over Time.

**CSAP – Reading**

Consistent with the other CSAP analyses, a mixed factorial ANOVA was conducted to determine the effects of SITW participation, time, and the interaction effect between SITW participation and time on CSAP reading scores. As shown in Table 8, reading test scores increased from year to year for both SITW and non-SITW students. In this case, the treatment and control group did not start with similar mean reading scores. The 3rd grade mean reading score for SITW students was 15.1 points less than the non-SITW students mean reading score. Over the course of the treatment, SITW students mean score increased 23.25 points from 3rd to 4th grade. Alternatively, non-SITW students mean reading score only increased 2.1 points over the same time period. A year removed from the treatment (5th grade), non-SITW students mean reading score increased 29.87 points, whereas SITW students mean reading score increased 22.71 points.
Table 8

*Descriptive Statistics – Colorado State Assessment Program Reading Scores*

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSAP 3rd Grade Reading Score</td>
<td>Non-SITW</td>
<td>60</td>
<td>632.30</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>617.20</td>
</tr>
<tr>
<td>CSAP 4th Grade Reading Score</td>
<td>Non-SITW</td>
<td>60</td>
<td>634.40</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>640.45</td>
</tr>
<tr>
<td>CSAP 5th Grade Reading Score</td>
<td>Non-SITW</td>
<td>60</td>
<td>664.27</td>
</tr>
<tr>
<td></td>
<td>SITW</td>
<td>44</td>
<td>663.16</td>
</tr>
</tbody>
</table>

The main effect of SITW participation yielded an F ratio of $F(1, 102) = 0.27, p=0.607, \eta^2_p = .003$, indicating no statistically significant difference between SITW students and non-SITW students with regards to CSAP reading scores. The main effect of time yielded an F ratio of $F(1, 102) = 63.04, p<0.001, \eta^2_p = .382$, indicating a statistically significant difference between 3rd, 4th, and 5th grade scores with regards to the CSAP reading assessment. The interaction effect between SITW participation and time yielded an F ratio of $F(1, 102) = 4.62, p=0.011, \eta^2_p = .043$, indicating a statistically significant interaction effect with regards to CSAP reading scores. This interaction effect demonstrated that over time CSAP reading scores significantly differed between SITW students and non-SITW students. Following up on this statistically significant interaction effect with a post hoc analysis, revealed that CSAP reading scores for SITW students increased at a significantly greater rate during the course of the treatment (3rd to 4th grade) when compared to non-SITW students, but the difference in growth between groups from
4\textsuperscript{th} to 5\textsuperscript{th} grade was not significant. While there was a statistically significant difference in non-SITW students from 4\textsuperscript{th} to 5\textsuperscript{th} grade, there was no statistically significant difference in non-SITW students from 3\textsuperscript{rd} to 4\textsuperscript{th} grade. A graph of the estimated marginal means for CSAP reading scores is presented in Figure 3 and displays this interaction. Furthermore, Table 9 shows the pairwise comparisons for CSAP reading scores.

\textit{Figure 3.} Estimated Marginal Means of Colorado State Assessment Program (CSAP) Reading Scores for School in the Woods (SITW) and Non-School in the Woods (Non-SITW) Students Over Time.
A multiple linear regression was performed to predict spring Scantron math scores based on group membership (SITW/non-SITW) and fall Scantron math scores. As shown in Table 10, Scantron math scores increased from fall to spring for both SITW and non-SITW students. In this case, the treatment and control groups started with relatively similar mean math scores in the fall of 4th grade and experienced relatively similar gains in math scores. From fall to spring, the SITW students’ mean math scores increased 139.82 points, and the non-SITW students’ math scores increased 164.83 points.
Table 10

*Descriptive Statistics – Scantron Math Scores*

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Scantron Math Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-SITW</td>
<td>66</td>
<td>2483.73</td>
<td>147.51</td>
</tr>
<tr>
<td>SITW</td>
<td>52</td>
<td>2531.35</td>
<td>119.63</td>
</tr>
<tr>
<td>Spring Scantron Math Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-SITW</td>
<td>66</td>
<td>2648.56</td>
<td>164.56</td>
</tr>
<tr>
<td>SITW</td>
<td>52</td>
<td>2671.17</td>
<td>123.92</td>
</tr>
</tbody>
</table>

A significant regression model was found $F(2, 115) = 54.135$, $p<.000$, with an $R^2 = .476$. This regression model was able to significantly predict spring math score and was able to account for 47.6 percent of the variance in spring math score. The results of the regression can be seen in Table 11. Fall math score was a significant predictor of spring math score, however group membership was not a significant predictor of spring math score. Fall math score was positively related to spring math score. Specifically, spring math scores increase 0.76 points for every 1 point increase in fall math score. A graph of the means of SITW and non-SITW students Scantron math scores is provided in Figure 4.
Table 11

*Multiple Linear Regression Predicting Spring Math Scantron Score From Group Membership and Fall Math Scantron Score*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE,B$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>770.71</td>
<td>182.04</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-13.93</td>
<td>20.15</td>
<td>-0.05</td>
<td>.508</td>
</tr>
<tr>
<td>Scantron Math Fall Score</td>
<td>0.76</td>
<td>0.07</td>
<td>0.70</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Figure 4.* Means of Scantron Math Scores for School in the Woods (SITW) and Non-School in the Woods (Non-SITW) Students Over Time.

**Scantron - Reading**

As with math, a multiple linear regression was performed to predict spring Scantron reading scores based on group membership (SITW/non-SITW) and fall Scantron reading scores. As shown in Table 12, Scantron reading scores increased from fall to spring for both SITW and non-SITW students. In this instance, the treatment and
control groups started with very different mean scores in the fall of 4th grade and ended up with very different mean scores in spring of 4th grade. The non-SITW students outperformed SITW students in both the fall and spring while and also exhibited a greater improvement from fall to spring. The non-SITW students’ mean reading scores increased 168.73 points, whereas the SITW students reading score increased 108.11 points.

Table 12

*Descriptive Statistics – Scantron Reading Scores*

<table>
<thead>
<tr>
<th>Group</th>
<th>Fall Scantron Reading Score</th>
<th>Spring Scantron Reading Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>n</em></td>
<td><em>M</em></td>
</tr>
<tr>
<td>Non-SITW</td>
<td>65</td>
<td>2757.31</td>
</tr>
<tr>
<td>SITW</td>
<td>52</td>
<td>2773.98</td>
</tr>
</tbody>
</table>

A significant regression model was found $F(2, 114) = 82.237, p<.000$, with an $R^2 = .583$. This regression model was able to significantly predict spring reading score and was able to account for 58.3% of the variance in spring reading score. The results of the regression can be seen in Table 13. The variables fall reading score and group membership were both found to be significant predictors of spring reading score. Fall reading score was positively related to spring reading score. Specifically, spring reading score increased 0.69 points for every 1 point increase in fall reading score. Overall, reading scores increased from fall to spring in both SITW and non-SITW students. However, non-SITW students’ reading scores were significantly greater in the spring as
compared to SITW students. Non-SITW students’ spring reading scores were 55.41 points greater than SITW students reading scores. A figure of the means for both SITW and non-SITW students’ Scantron reading scores is presented in Figure 5.

Table 13

*Multiple Linear Regression Predicting Spring Reading Scantron Score From Group Membership and Fall Reading Scantron Score*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
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<td></td>
</tr>
<tr>
<td>Group</td>
<td>-55.41</td>
<td>22.52</td>
<td>-0.15</td>
<td>.015</td>
</tr>
<tr>
<td>Scantron Reading Fall Score</td>
<td>0.69</td>
<td>0.05</td>
<td>0.76</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Figure 5. Means of Scantron Reading Scores for School in the Woods (SITW) and Non-School in the Woods (Non-SITW) Students Over Time.*
**Summary**

With regard to the proximal measures (CSAP writing, math, and reading) of academic achievement, the main effect of SITW participation was not statistically significant. In each of the three mixed factorial ANOVAs, the between-subjects factor of group membership was not significant. The main effect of the within-subjects factor of time was found to be statistically significant in all the models. The interaction effect between SITW participation and time was found to be statistically significant with regard to CSAP reading scores, but not with regard to CSAP math or writing scores. This interaction effect demonstrated that over time CSAP reading scores significantly differed between SITW students and non-SITW students. SITW students’ scores increased at a significantly greater rate than non-SITW students on the CSAP reading assessment during the time of the treatment (4th grade).

With regard to the distal measures (Scantron math and reading) of academic achievement, both regression models found the fall score to be a significant predictor of spring score. Group membership (SITW/non-SITW) was found to be significant predictor of spring reading score but not found to be a significant predictor of spring math score. From fall to spring, non-SITW students’ scores showed a greater increase than SITW students on the Scantron reading assessment, and the difference between groups in spring scores was significantly different, with non-SITW scores outpacing those of SITW. This finding, with relation to the distal measure of reading (Scantron), contradicts the finding related to the proximal measure of reading (CSAP). In the proximal measure of reading, SITW participation had a positive impact on reading
achievement. In the distal measure of reading, SITW participation had a comparatively negative impact on reading achievement.
CHAPTER 5

DISCUSSION

This chapter presents a summary of the study and provides a discussion and interpretation of the findings presented in Chapter 4. This portion of the dissertation also examines the implications of the research and makes recommendations relevant to educational practice and further research.

Summary

This research study utilized an experimental design to examine the effect of a fourth grade environment-based education program on student academic achievement across multiple disciplines. The initiative, the School in the Woods (SITW), is a yearlong immersive program that utilizes the surrounding natural environment as the context for teaching and learning the state mandated curriculum and standards. Employing random assignment, the overall goal of this research was to assess if there was a significant difference in academic achievement between a treatment group of students who attended School in the Woods and a control group of students who attended traditional elementary schools in the same school district.

Findings from the analysis of the proximal and most direct measure of academic achievement, the Colorado State Assessment Program (CSAP), revealed a statistically significant difference between SITW and non-SITW students in reading. The repeated measures mixed factorial ANOVA analysis revealed that SITW students’ scores
increased at a significantly greater rate than non-SITW students while attending School in the Woods. A review of the descriptive statistics indicated that while not reaching statistical significance, a similar pattern emerged in both the writing and math scores as SITW students experienced greater gains than non-SITW students while enrolled at School in the Woods. Interestingly, this trend did not persist when the SITW students returned to traditional elementary schools. A year removed from the treatment, non-SITW students experienced greater achievement gains in writing, math, and reading than SITW students.

Findings from the analysis of the distal and indirect measure of academic achievement, the Scantron Performance Series, found group membership (SITW/non-SITW) to be a significant predictor of spring reading score, but not spring math score. The multiple linear regression analysis demonstrated that non-SITW students performed better than SITW students in reading. This distal finding contradicts the proximal finding related to reading. In the proximal measure of reading, SITW participation had a positive impact as measured by state-mandated standards. In the distal measure of reading, SITW participation had a comparatively negative impact as measured by a conventional instrument. The proceeding discussion provides an interpretation of these contrary findings.

The fact that CSAP reading gains were statistically significant different between the two groups in fourth grade but not in fifth suggests that School in the Woods students appeared to benefit from attending the school; however, these positive outcomes did not persist when they returned to traditional schools. This implies that something positive
was occurring at School in the Woods, at least in reading, but these encouraging outcomes did not transfer to 5th grade.

As a construct in educational psychology, the “transfer” of learning refers to the ability of a student to carry the product of learning from one task, problem, situation, or institution to another (Beach, 1999). In other words, it is the quest to see if knowledge or skill learned in one context will be repeated or utilized in another context (Detterman, 1993; Greeno, Moore, & Smith, 1993). Unfortunately, a great unknown in the field of outdoor education is the lasting value of educational experiences and how learning transfers (Leberman & Martin, 2004; Sibthorp et al., 2011; Wolfe & Samdahl, 2005). Given the patterns that emerged in the state assessment data in this research, it appeared the impacts of School in the Woods participation did not transfer well.

One explanation for the lack of longitudinal outcomes associated with this program may be the effect of culture shock. The expression “culture shock” is not a clinical term or medical condition, it is a theory attributed to the anthropologist Kalevro Oberg. Oberg (1960) conceptualized the anxiety and frustrations experienced by an individual when they leave a familiar culture and transition to a new culture. Six negative characteristics have been associated with culture shock that include: strain or stress relating to psychological adaptation; a sense of loss or deprivation resulting from the removal of friends; feelings of rejection by a new culture; confusion in role expectation, values, and feelings; anxiety at realization of cultural differences; and feelings of helplessness with along with the inability to cope with or integrate into the new environment (Oberg, 1960).
School in the Woods students may experience this culture shock phenomenon when they transitioned to 5th grade. The immersive experience at School in the Woods leads to the development of a unique culture and strong community. Anecdotal feedback from parents of School in the Woods alumni frequently reports that students struggle with the transition to the traditional classroom environment. Holding constant the challenge of moving from an environment-based school to a traditional school, the challenge alone of transitioning between schools is also difficult for students. Previous research has shown that students suffer academically when transitioning between schools (Alspaugh, 1998). This struggle with transitioning has been attributable to a loss of self-esteem and self-perception that accompany school-to-school transitions (Wigfield et al., 1991).

The founders of the School in the Woods were aware of this potential struggle with transitioning and this understanding was behind the decision to limit the school to 4th graders. The developers of the school recognized that a period of cultural acclimatization would be experienced by School in the Woods students when they transitioned to traditional schools, and they wanted to structurally ease this transition. Thus, the objective in choosing 4th graders for this program was to give School in the Woods students the 5th grade year to re-adapt to traditional schooling before being asked students to make the jump to middle school. Effectively, the founders of the school did not want to force the students to experience an even greater feeling of culture shock by requiring them to simultaneously transition to both a traditional classroom and a new middle school. This concept may contribute understanding toward explaining the absence of impacts in School in the Woods students a year removed from the treatment.
Another explanation for the lack of longitudinal outcomes associated with this program may be the influence of the fade-out effect. Often referred to as the “fade out phenomenon,” the research in early childhood programs generally indicates that treatment groups receive immediate benefits upon completion of an intervention; however, these positive outcomes rarely persist (Crane & Barg, 2003; Gomby et al., 1995). Specifically, a consistent finding in experimental studies researching achievement-related skills in young children is that initial treatment effects diminish over time as the control group catches up to the treatment group (United States Department of Health and Human Services, 2010). The fade-out effect has also been explicitly noted in the field of outdoor education as students often experience a regression post course (Hattie et al., 1997). This fade-out effect may help to explain the absence of longitudinal impacts in the School in the Woods students.

In addition to these potential explanations for the lack of longitudinal effect, the results may also be a statistical phenomenon. Specifically, the small sample size \( n=124 \) increased the opportunity for a Type II error to occur. In a Type II error, due to a lack of adequate statistical power, the analysis fails to observe a difference, when in reality a difference does exist. In this study, the p-values of the interaction term approached statistical significance in both the writing \( (p=0.11) \) and math \( (p=0.19) \) analysis. A larger sample size would have increased the statistical power and thus may have yielded a statistically significant difference between SITW and non-SITW students.

Another statistical explanation may be the possible influence of a ceiling effect. As previously outlined in Chapter 3, the sample for this study was drawn from a high achieving population. The school district in which the School in the Woods resides is
one of the highest performing school districts in the state. The “ceiling effect” in this context refers to an invisible barrier facing high-achieving students wherein they can only improve test scores incrementally. Test score ceilings structurally restrict students’ test score gains as test score levels rise (Koedel & Betts, 2009). In other words, due to the fact that high achieving students are in the upper tier of the scaled scores, only minimal improvements are possible. Given this context, the students in this research study had little opportunity to significantly increase test scores. Hence, it was possible that the ceiling effect may have been masking results as well.

One dimension that has been identified as affecting an assessment’s accuracy is its proximity to instruction (Ruiz-Primo et al., 2002) In reference to the Scantron Performance Series and its contrary results with CSAP analyses, this may be because Scantron assessment is a distal measure of learning and far-removed from the curriculum. Distal measures do not necessarily reflect the specific content that was covered in any particular classroom (Pellegrino, 2014). The content assessed on the Scantron instruments was not directly aligned to the school curriculum and state-mandated standards. It was an assessment used district-wide to inform instruction and assess gaps in individual student achievement. In contrast, CSAP was a proximal measure of learning designed to provide an annual measure of student performance relative to the Colorado Model Content Standards.

Given the different designs and proximity of the assessments to the curriculum, one may presume to see differing results when comparing proximal and distal measures. Proximal level measures consider the knowledge and skills close to the curriculum, whereas distal measures are only minimally related to a specific curriculum and offer the
weakest effects of the intervention (Ruiz-Primo et al., 2002). Previous research has shown that the magnitude of treatment effects decreases as the distance of the assessment from the curriculum increases (Lara-Alecio et al., 2012; Ruiz-Primo et al., 2002).

Specifically, research exploring a large-scale science intervention found that proximal measures had a greater ability to detect students’ improvement on assessments, while distal measures were less effective (Llosa et al., 2016).

Another factor that may have influenced Scantron scores was computer familiarity. The Scantron assessment was a computer-based instrument. In contrast, the CSAP assessment was a traditional paper and pencil exam. As an environment-based program, the School in the Woods focuses on teaching and learning in the natural environment and subsequently does not place a great deal of emphasis on technology. The School in the Woods does have a computer lab, and computers are utilized at the school; however, generally School in the Woods students use computers less frequently than traditional students in the school district. Research has noted that the level of computer experience that students possess is of critical importance with computer-based testing, as this has a potential impact on test-score validity (Parshall et al., 2002). Parshall et al. (2002) point out that the level of prior computer experience may be systematically different across subgroups of students in a sample and thus is an important equity concern when testing across populations. Given the context of School in the Woods, these students may not have been as comfortable completing a computer based assessment and this may have negatively impacted their performance. This distinction in test administration may explain some of the variation in performance between SITW and non-SITW students on these exams.
The fact that there were such inconsistencies, positive results, negative results, and/or non-significant findings in some ways makes this study unique. The vast majority of prior works report positive and significant findings (Glenn, 2000; Lieberman & Hoody, 1998; SEER, 2005), and none appear to report negative findings. Publication bias is a frequent occurrence in research as the publication of study results is often based on the direction or significance of the findings (Dickerson, 1990). Specifically, publication bias is a common issue in this field as other authors have reported that the emphasis on positive findings and ignoring of negative evidence is disturbingly common in outdoor education (Hattie et al., 1997).

Implications

It is clear that the accountability and standardization movement is here for the foreseeable future. The recent passage of the Every Student Succeeds Act (ESSA) in 2015 continues in the direction of the No Child Left Behind (NCLB) Act of 2002 and requires annual statewide assessments to measure students’ progress towards educational standards (ESSA, 2015). In line with NCLB, the ESSA legislation maintains an expectation that states and districts will be accountable for reaching educational standards on mandated assessments. Considering the current national climate, demonstrating that environment-based education can be effective in raising test scores on state-mandated assessments will be critical in supporting the model’s continued use. This research is significant as the results suggest that there may be positive effects associated with environment-based education in relation to state-mandated educational standards; however, various limitations made it difficult to justify this conclusively.

If subsequent research were to overcome some of the limitations present in this
study and confirm the efficacy of environment-based education, this would suggest an important implication not only for education generally but also for children’s well-being. As the agenda for public education is increasingly determined by state and national education policies, a growing schism between schools and local communities has resulted (McInerney, Smyth, & Down, 2011). In many schools, the four walls of the classroom bound the educational experience, and this is contributing to a growing gap between children and the environment (Lieberman, 2013). This divide between children and the natural world is troubling as children often demonstrate an inborn curiosity and affinity for the natural world. However, this inquisitiveness is rarely harnessed in schools. Louv (2005) coined the term “Nature-Deficit Disorder” to call attention to the fact that children are now spending significantly less time outdoors, and this is resulting in a wide range of mental health problems. This research is relevant as environment-based education could well provide a means of overcoming the division between the schools and the natural environment. In doing so, students, communities, and the environment could all be beneficiaries.

As mental health issues come to the forefront of society’s attention, it is important to understand how environment-based education interacts with these outcomes. Children in the United States are currently experiencing an unprecedented set of mental health problems. These problems include increased levels of depression, cognitive disabilities, attention disorders, and hypertension (Louv, 2005). It is estimated that 13-20% of children living in the United States experience a mental disorder and an estimated $247 billion is spent annually on childhood mental disorders (O’Connell, Boat, & Warner, 2009).
Previous research has shown a relationship between the environment and mental health (Louv, 2005). Evidence suggests that access to nature and green space provides children with a myriad of cognitive and emotional benefits, such as an increased ability to concentrate, reduced stress, and lower levels of aggression (Faber, Taylor, & Kuo, 2006; Kaplan, 1995; Strife & Downey, 2009; Wells & Evans, 2003). By bolstering children’s attention resources and capacities, learning outdoors may enable children to think more clearly and cope more effectively with stress (Wells, 2000).

One concept that may help to explain the positive mental benefits associated with nature is Attention Restoration Theory, which proposes that natural environment assists in attentional functioning (Kaplan, 1995). In this theory, the environment is restorative in the sense that it assists the mind in recovery from attention fatigue. The theory holds that the natural environment engages the mind effortlessly, and thus it provides a respite from having to deliberately direct attention (Kaplan, 1995). To give this context, a common issue in school is that children’s schoolwork requires extended periods of deliberate, effortful attention. In an indoor classroom environment children often must carry out these tasks in a context filled with powerful distractions that constantly demand attention and make it extremely difficult to concentrate on the task at hand. One solution may be to take students outdoors to an attentionally supportive environment that restores students’ mental energy. The School in the Woods employs this strategy on a regular basis as each student has their own individual “solo spot” in the forest. These solo spots provide students with a respite from the distractions of the classroom and offer them the independent space to concentrate and process learning.

Research has indicated that the environment can help foster an inner peace and
renewal of mental energy (Kaplan, 1995). Furthermore, experiences in nature are commonly associated with positive emotions (Hartig, 2001). As the famous naturalist, John Muir recommended,

Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop away from you like the leaves of Autumn. (Muir, 1901, p. 56)

Perhaps environment-based education can harness the restorative effects of the environment as outlined by Muir and Kaplan. As such, future research should continue to investigate how the natural environment influences mental health and specifically how environment-based education may be associated with these outcomes.

Another benefit that may result from environment-based education is student engagement and motivation. This quality stands out prominently when visiting the students at School in the Woods as these students are deeply immersed in the experience and excited about learning. Overall, increasing student motivation is a significant issue as this variable has been identified as holding great potential for improving student achievement (National Research Council, 1999). Previous research has shown that students with positive motivational beliefs will be more likely to become engaged in learning in a deeper, more self-regulating fashion than those who do not have these beliefs (Pintrich & Schrauben, 1992). The subject of student motivation is especially critical because research has shown that students lose their natural curiosity and enthusiasm for learning as they progress through schooling (National Research Council, 1999).
Research specifically investigating academic motivation and student engagement with relation to environment-based education has shown a positive effect (Monroe & Athman, 2004; Powers, 2004; Von Secker, 2004). Teachers have reported that environment-based students were more engaged when learning outdoors (Powers, 2004). Furthermore, students have reported higher levels of engagement with environment-based education (Von Secker, 2004). Specific to the present study, students at School in the Woods are enthusiastic about school and are actively involved in the learning process. The “naturalists” (students) embrace the constructivist learning principles of environment-based education and assume ownership for learning. For example, the students are given complete autonomy in the development of their month-long spring field project. The students embrace the independence associated with taking control of the direction of their learning. Overall, the academic freedom inherit within the environment-based approach along with learning context seems to encourage student motivation and promote engagement.

Historically, education involving the natural environment has often been viewed as an additional subject for which teachers and administrators had to find extra time. However, environment-based education counteracts this notion by re-envisioning an integrated curriculum that unifies core subject areas around the natural environment. By interweaving academic content through interdisciplinary instruction, environment-based education becomes not simply another add-on to academic studies, but an engaging, integrating medium for multiple subjects (Lieberman, 2013). The findings from this research suggest environment-based education does not take away from learning in the core subject areas and may have the potential to be effective in reaching state-mandated
Recommendations

One of the strengths of environment-based education is its ability to adapt to the unique characteristics of a particular place. One recommendation for practice that arose from this research is the suggestion that educators explore local opportunities for environment-based education. Wherever a school is situated, whether urban, rural, or suburban, educators have the ability to utilize the environment to successfully design, adapt, and implement programs that are effective because they are based on locales that have meaning for their students (Liebermann, 2013). Recognizing that access to the environment may be a challenge, this approach is flexible and malleable to a range of environments, such as schoolyards, local parks, open spaces, gardens/farms, wetlands, and other various outdoor places. Overall, while the School in the Woods utilized a rural forested environment, there are many diverse opportunities for educators to use local environments and communities to integrate learning and support content driven by state-mandated standards.

An example of an urban school implementing environment-based education is Hawley Elementary School in Milwaukee, Wisconsin (Glenn, 2000). The school is located in an urban center and is flanked on three sides by streets and on the fourth by a paved playground. In order to apply the principles of environment-based education, the school has developed a greenhouse, multiple gardens, an environmental education resource room, an aquaponics lab, and a partnership with Milwaukee Urban Ecology Center. Additionally, the teachers at the school are encouraged to utilize a designated outdoor classroom that serves as a relaxing learning area. Hawley's curriculum is
designed to integrate environmental education into all subject areas and get students outside as much as possible (Glenn, 2000).

An example of a suburban school implementing environment-based education is Brookside Elementary School in Oak Park, California (SEER, 2000). Throughout the school year, Brookside students make use of an array of outdoor instructional settings to implement environment-based education. The school has campus gardens that are used to connect students’ knowledge and skills in a number of subject areas. Teachers integrate content standards into garden-based lessons, linking garden study to disciplinary areas throughout the curriculum (SEER, 2000). The school also partners with the Center for Ecoliteracy to give students first-hand knowledge of creek-side habitats through their work on riparian restoration projects. This school is involved with the STRAW (Students and Teachers Restoring A Watershed) Project in the San Francisco Bay Area.

A distinguishing quality of environment-based education is its ability to be implemented in varying degrees. Hence, an additional recommendation for practice that surfaced from this research is the suggestion that educators start small. Environment-based education does not have to require a complete re-imagination of classroom instruction. It can be as unassuming and simple as giving students 30 minutes each day to journal in a schoolyard. It does not have to require extensive planning or necessitate additional funding. Additionally, implementing environment-based education does not have to demand a district commitment or school wide reform effort, it can occur at the classroom level. It only requires that educators look for ways to extend their classroom to the natural environment.

A number of recommendations for further research arose from this dissertation.
One such recommendation is that forthcoming scholarship concerning this initiative explore alternative measures such as outcomes associated with the environment and science achievement. Given the context of the school, it would be interesting to assess these outcomes. One well-established instrument that could be employed is the CHEAKS (Children’s Environmental Attitude Knowledge Scale) Assessment as it measures environmental attitudes and knowledge (Leeming & Dwyer, 1995).

One suggestion for future analysis is to further explore longitudinal outcomes that may be associated with School in the Woods. It would require engaging alumni in research, as the school has an established history. Longitudinal research could contribute additional data to further assess the impact of School in the Woods.

Another recommendation for future research is to investigate the mental health outcomes associated with environment-based education. Additionally, prospective scholarship could examine how environment-based education impacts student engagement and motivation. These variables are believed to be essential elements in the education model.

A concluding recommendation that arose from this study is the need for further qualitative research on the impact of environment-based education. This research addressed “what” the impact of this environment-based education was on academic achievement. However, there is still a need to understand more fully “why” this occurred. Qualitative inquiry can help explain “how” environment-based education affects students. Methodologically sound qualitative research would serve to compliment the growing body of quantitative research.

Finally, prior literature on environment-based education is exclusively positive in
its outcomes, while results from this study suggest there may be reason to be more
circumspect about achievement outcomes. Further research would benefit from more
rigorous methodological designs and analyses with robust sample sizes that would
facilitate strong causal claims.
References


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Appendix

**University of Colorado\nColorado Springs\nInstitutional Review Board (IRB) for the Protection of Human Subjects**

Date: 11/13/2015

**IRB Review**

**APPROVED**

**IRB PROTOCOL NO.: 10-212**

Protocol Title: Exploring the influence of natural science based educational initiative on student achievement using random assignment

Principal Investigator: Daniel Bowan

Faculty Advisor if Applicable: Dick Carpenter

Application: Renewal

Type of Review: Expedited 7

Risk Level: No more than Minimal Risk

Renewal Review Level (If changed from original approval) if Applicable: N/A No Change

This Protocol involves a Vulnerable Population: N/A (No Vulnerable Population)

Expires: 14 November 2016

*Note, if exempt: If there are no major changes in the research, protocol does not require review on a continuing basis by the IRB. In addition, the protocol may match more than one review category not listed.

Externally funded: ☒ No ☐ Yes

OSP #: Sponsor:

Thank you for submitting your Request for IRB Review for renewal of an approved protocol. The protocol identified above has been reviewed according to the policies of this institution and the provisions of applicable federal regulations. The review category is noted above, along with the expiration date, if applicable.

Once human participant research has been approved, it is the Principal Investigator’s (PI) responsibility to report any changes in research activity related to the project:

- The PI must provide the IRB with all protocol and consent form amendments and revisions.
- The IRB must approve these changes prior to implementation.
- All advertisements recruiting study subjects must also receive prior approval by the IRB.
- The PI must promptly inform the IRB of all unanticipated serious adverse (within 24 hours). All unanticipated adverse events must be reported to the IRB within 1 week (see 45CFR46.103(b)(5)). Failure to comply with these federally mandated responsibilities may result in suspension or termination of the project.
- Renew study with the IRB prior to expiration.
- Notify the IRB when the study is complete

If you have any questions, please contact Research Compliance Specialist in the Office of Sponsored Programs at 719-255-3903 or irb@uccs.edu

Thank you for your concern about human subject protection issues, and good luck with your research.

Sincerely yours,

**Zek Cypress Valkyrie**

Zek Cypress Valkyrie, PhD
IRB Reviewer

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Version 2/12/13