KNOWLEDGE, VALUES, AND ACTION FOR SUSTAINABILITY: ENVIRONMENTAL EDUCATION FOR THE 21st CENTURY

by

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ABSTRACT

This paper takes the position that the evidence of growing environmental and social crises necessitates a broad-based, collective response that identifies and addresses fundamental causes of these challenges by providing children (and their communities) with opportunities to develop knowledge and values to act for sustainability and social justice. Environmental education represents one possible strategy for addressing the global challenge posed by social and ecological crises. Therefore, this paper seeks to answer the question, “Do environmental education programs effectively promote environmentally sustainable values and actions in their participants?”

A critical review of literature on environmental education published between 1998 and 2008 found that a wide variety of programs, curricula, and experiences are capable of increasing students’ environmental knowledge and improving their attitudes toward the environment. However, studies showed that the presence of pro-environmental knowledge or attitudes did not necessarily result in increased environmentally responsible behavior. Beyond the complexity of the knowledge-values-action nexus, this paper also found that integrated, environment-based education programs had an overwhelmingly positive impact on students’ academic achievement.

In addition to offering constructive suggestions for further research, it is my sincere hope that this paper contributes to the theorization and practice of empowering and transformative environmental education.

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CHAPTER ONE: INTRODUCTION

Rationale

> We know enough of our own history by now to be aware that people exploit what they have merely concluded to be of value, but they defend what they love. To defend what we love we need a particularizing language, for we love what we particularly know. (Berry, 2000)

The earth is being destroyed. The Millennium Ecosystem Assessment (2005), a definitive United Nations-commissioned survey of global environmental trends, paints an unambiguously bleak picture. Details of the portrait include vanishing biodiversity, massive deforestation, widespread pollution, and the disastrous consequences of global climate change. Anthropogenic climate change, in particular, has captured the attention of global civil society and has been unequivocally validated by the international scientific community (IPCC, 2007). The MEA report also notes growing poverty, hunger, and declining access to fresh water for much of the world's population.

More than 508 million people in 31 countries face water scarcity today and, by 2025, this number will increase to 3 billion – almost 50% of the world's population (UNFPA, 2001). Communities from sub-Saharan Africa to the southwestern United States are impacted by declining access to fresh water. In the U.S., the majority of citizens live within ten miles of polluted water that is unsafe for drinking, fishing, or swimming (UNFPA, 2001). Over 40% of

groundwater in the U.S. has been contaminated by industrial, agricultural, and household pollution (Population Connection, 2002).

The earth loses one entire plant or animal species every twenty minutes – almost 27,000 species per year. Habitat loss due to unsustainable human development practices remains the most critical threat to biodiversity (Population Connection, 2002). Efforts to relate the loss of biodiversity to the loss of cultural and linguistic diversity provide compelling evidence of an unprecedented wave of global homogenization now well underway (Maffi, 2001). As wild and rural or agricultural landscapes are transformed, human populations are displaced, spurring massive urban migration. While the number of people living in 58 U.S. metropolitan areas rose 80% between 1950 and 1990, the land covered by those areas expanded 305% (Population Connection, 2002).

Six million acres of prime farmland, an area the size of Vermont, were lost in the United States alone between 1982 and 1992 (Population Connection, 2002). In India, Roy (1999) estimated the number of people displaced due to hydroelectric dam construction at over 32 million in the last 50 years. Figures for China are less transparent, but conservative estimates include tens of millions of displaced people and thousands of submerged villages (UNWCD, 2000). The concurrent urbanization of the world's population has resulted in the decline of traditional ways of knowing, from ethnobotany to sustainable farming practices to language and culture (UNFPA, 2007) and the separation of humans from nature (Turner, Nakamura, & Dinetti, 2004). Ecological and social crises are inextricably linked and accelerating.

Responses to these crises can be found in a wide range of forms, from individual consumptive choices (buying compact fluorescent light bulbs) to international treaties brokered between nation-states (the Kyoto Protocol). An analysis of the world's most serious environmental problems suggests limits to the effectiveness of individual, private action. The United States is far and away the world's leading per capita consumer of energy and natural resources. In 2000, for instance, the US used about 23 percent of the world's energy despite having less than 5 percent of its population (Clayton, 2004). However, individuals account for only one third of energy use, pollution, and solid waste while the vast majority is consumed (or produced) by business, industry, and government (Gardner & Stern, 2002).

These figures suggest the need for widespread collective action to halt ecological destruction. Environmental education represents an important strategy to do so. Revered author and environmentalist Knapp described the origin and goals of environmental education:

> The EE field was born in the 1970s out of growing discontent with how we (especially Americans) were treating the air, water, plants, soil, and animals, and how schools were preparing future citizens to make intelligent decisions concerning the environment. The field was launched by people who thought education was one of the essential remedies for solving these problems, and educators chose to use schools to change individual and societal lifestyles to that end (ICEE, 1997).

Although the definition, purpose and practice of environmental education vary widely, it is the author's intention to critically review available research to determine different approaches' potential to address the unprecedented challenges all life on earth face.

Does environmental education have the power to transform our cultural and ecological relationships from the grassroots – beginning with the knowledge, values, and actions of children growing in our communities?

Barriers to Implementation of Environmental Education

Environmental education has the potential to generate critical questioning of many of our deep-seated cultural beliefs and assumptions regarding production, consumption, progress, and anthropocentrism (Cajete, 1994; Orr, 1994). Before reviewing the effectiveness of contemporary environmental education programs and curricula, it must be noted that there remain significant social, cultural, and political barriers to the widespread implementation of EE. Since at least the publication of *A Nation at Risk* (NCEE, 1983) there has been a steady march toward standards-based reform of public schools in the United States. The seminal report focused on the faltering status of the US in the global economy and the need for a more highly skilled and trained workforce to compete internationally. Though much has changed over the past twenty-five years, the broadly stated and accepted goals for public education described in the report have changed little. Successive administrations, both Democratic and Republican, have eagerly linked the needs of business and the economy to the role of education in our society (Spring, 2008). The culmination of this top-down

movement was, without question, the No Child Left Behind Act of 2001. NCLB represented the federal government's attempt to create a nationwide standards regime for public education. With federal education funds now tied to measurements of school-wide annual yearly progress on standardized tests, teachers face increasing pressure to focus exclusively on traditional academic subjects defined in the narrowest of terms. The school reform climate is so desperate that, in some school districts, teachers and students are being financially rewarded for success on standardized tests (Blumenthal, 2006; Medina, 2008).

Despite the potential shadow cast over EE by legislation like NCLB and its proponents, a widespread mandate for environmental education exists throughout the public school system in the United States. Currently, 31 states require schools to incorporate environmental concepts throughout subject areas and across grade levels, and at least four states require training in sustainability education as part of the teacher certification process (Cushman, 1997). For example, Washington State Professional Educator Standard Board (PESB) Standard 5.3.D (Knowledge of Learners and their Development in Social Contexts) requires that "teacher candidate practice reflects planning, instruction, and communication in which... all students are prepared to be responsible citizens for an environmentally sustainable, globally interconnected, and diverse society" (Wheeler & Thumlert, 2007). Despite the continued mainstreaming of EE, conservative critics challenge the perceived politicization of environmental education (sometimes referred to as advocacy creep), criticize common EE

pedagogical approaches, and question the quality of its scientific bases (Cushman, 1997). Though these criticisms of environmental education have relied largely on anecdotal evidence, they continue to hold some measure of popular appeal (ICEE, 1997). Nevertheless, the most recent nationwide poll in the US found that 95% of parents supported teaching environmental education in schools, a clear indication that awareness of environmental problems is growing and a recognition that EE represents a viable strategy to address those problems (Roper-Starch, 2000).

This paper takes the position that the evidence of environmental and social crises necessitates a broad-based, collective response that identifies and addresses fundamental causes of these challenges by providing children (and their communities) with opportunities to develop knowledge and values to act for sustainability and social justice.

Statement of Purpose

Given the findings of the Millennium Ecosystem Assessment (2005) and similar global studies, as well as our everyday observations and experiences, we grow increasingly aware of the dire social and ecological crises wrought by our cultural and economic systems. A dramatic transformation of human relationships with the earth and, indeed, each other, is necessary for the continued sustenance of life on earth. The underlying assumption of this paper is that schools are a potentially critical location for broad, cultural changes to take root and foster action to that end. This paper will review the history and effectiveness of environmental education in K-8 public schools in the United

States and beyond. Effectiveness will be determined by environmental education programs' impact on students' beliefs, attitudes and actions toward ecological sustainability and social justice. When available, information on what sorts of measurable, beneficial outcomes ecosystems and communities have experienced as a result of such programs will be highlighted. The goal of this paper is to identify and promote environmental education that is deeply empowering, both individually and socially transformative. Therefore, this paper seeks to critically review available literature to determine the effectiveness of contemporary environmental education programs in promoting environmentally sustainable values and actions in their student participants.

Definition of Terms

There are a host of terms used throughout this paper with wildly divergent meanings in both popular and academic discourses. These definitions serve to orient the reader to the author's intended use of the following terms.

- Environmental Education – A diverse range of educational practices, both in and outside of schools, concerned generally with promoting awareness and knowledge of environments in order to positively impact their care and conservation. Differences in the values, practices and goals of environmental education will be explored in chapter two, their outcomes in chapter three, and reformative suggestions offered in chapter four.
- Sustainability – A recognition of the fundamental relationship that exists between human activities and the natural world, that the wellbeing – the very survival – of current and future humans depends upon the health and

- Place-Based Education – Place-based education is a holistic approach to education, ecological sustainability and community development that uses local environments as an integrating context for learning.
- Environment – Both natural and built environments. As a broad-based context for learning, incorporates local history, economics, landscape, community infrastructure, watersheds, cultural traditions and more (Sobel, 2004).
- Culture – Following Rogoff (2003), culture is a set of integrated, yet changing, activities that make up a community's way of life. This includes values, traditions, and technologies/tools such as language that shape cultural practices and participation.

Limitations

This paper focuses on environmental change and education in industrialized, Western nations such as England, Norway, Denmark, Australia, and the United States. Originally, in accordance with place-based education's attempt to situate study in the "immediate, personal, and local," I sought to relegate the research base to the United States (Woodhouse, 2001). As the research process began in earnest, I found that the field of environmental education research involved diverse samples from around the world and that, despite differences in nationality, significant parallels emerged. For example,

people in North America, Central America, Europe, Africa and Australia have reported similar childhood experiences that have played a crucial role in their development of an active commitment toward the environment as adults (Chawla, 1998). From Wisconsin to Germany (Sivek, 2002; Bögelhoz, 2006), Kentucky to Norway (Chawla, 1999), current research indicates patterns in the development of environmentally responsible behavior for both children and adults that highlights the need for a broad, international base of studies. As stated in the rationale, the environment is a globally interdependent system knowing no national, politically constructed borders. In order to meet the greatest socioecological challenge of our age, a concerted international effort is necessary. Though the environmental issues facing people around the world share both similarities and differences, environmental education research must look to localized strategies and solutions everywhere.

I focused on the United States to provide historical background and context for my research. By focusing on the social and political history of EE and the environmental movement more broadly here in the U.S., I will be more readily able to translate findings into a workable framework to develop a critical pedagogy of place in my future teaching practice. This consideration – relevance to future teaching practice – directed my paper to look primarily at K-12 public school students as well. Finally, although I have sought to be comprehensive, my research is by no means exhaustive. Indeed, incredible programs and curricula surely exist outside the documented realm of English language journals, databases, and the like. For example, the majority of information about

ecopedagogy theory and practice is available only in Portuguese. Time, space, and access to resources also shaped my course of study.

Despite these limitations, it is my sincere hope that this paper contributes to the theorization and practice of empowering and transformative environmental education.

Summary

Given the findings of contemporary global environmental assessments, Gadotti (2003) was perhaps not overstating the urgency of the crisis facing humankind when writing "we have perhaps a little over 50 years to decide whether we wish to destroy or preserve the planet" (p. 1). Environmental education represents one possible strategy for addressing the global challenge posed by social and ecological crises. This paper will attempt to identify and promote environmental education that is deeply critical, empowering, and transformative. Therefore, this paper seeks to critically review available literature to determine the effectiveness of contemporary environmental education programs in promoting environmentally sustainable beliefs and actions in their student participants.

In order to understand how EE developed in the latter decades of the 20th century, Chapter Two will situate its emergence and current practices in various educational movements and the broader social-historical contexts in which they developed. Chapter Three provides a critical review of contemporary research literature on the efficacy of a wide variety of environmental education programs and curricula. Finally, Chapter Four summarizes and critiques the research

presented in Chapter Three and discusses implications for both classroom teachers and future environmental education researchers.

CHAPTER TWO: HISTORICAL BACKGROUND

Introduction

While environmental education as a distinct field did not come about until the late 1960s, its roots can be traced to the turn of the 20th century with the emergence of three educational movements whose influences are still felt today — nature study, conservation education, and outdoor education. Their impact on the environmental field can be seen in the outdoor classrooms, nature trails and wilderness experiences that are often components of current environmental education curricula. Over the past three decades, however, the limited definition and practice of nature education gave way to the much broader field of environmental education, often abbreviated as EE. In order to understand how EE developed in the latter decades of the 20th century, we need to situate its emergence and current practices in these educational movements and the broader social-historical contexts in which they developed.

The first section of this chapter will explore the discipline of natural history and the concept of conservation education in the late nineteenth and early twentieth centuries. In the second section, the growth and formalization of EE in the 1960s and 1970s is viewed in light of broader social and environmental movements in the United States and abroad. Finally, section three charts the most significant trends in contemporary EE and sustainability education, framing current conceptualizations and practices between those who view EE as a means to radically transform society and those who view EE as a means to aid

standards-based reform and promote academic achievement in U.S. public schools.

The 19th and Early 20th Centuries: The Roots of Environmental Education

Natural history was among the most respected and popular educational disciplines at the end of the nineteenth century. Gruenewald (2003a) described natural history as an "interdisciplinary educational tradition that can remind educators of the need to create the time and space for experiencing, exploring, and discovering a diversity of living places and the diversity within them" (p. 638). Jackman (1892) is widely considered to have created the principles and guidelines of the nature study movement in education with the publication of *Nature Study for the Common Schools*. Primarily a teacher training manual and curriculum planning guide, Jackman arranged the text as a series of interdisciplinary scientific questions to be pursued by students' hands-on exploration of the natural world. He wrote:

> The life, health, and happiness of the individual is dependent upon his knowledge of the things about him, and upon the understanding that he has of their relations to each other and to himself. This knowledge and apprehension of relations can only be acquired by actual personal contact and experience with the things and forces which make up and govern the universe (Jackman, p. 1).

Pyle (2001) traced the history of nature studies and contended that the popularity of natural history among the general public contributed to its

proliferation in schools and universities. The *Handbook of Nature Study,* a field and training guide for teachers to introduce nature studies to students, was published in 24 editions in the 28 years since its original publication in 1911. In it, Comstock (1911) identified numerous goals for nature study: gaining practical knowledge, health and fitness, cultivating imagination, and refining powers of observation and interpretation. Above all, however, nature study ought to

> give the child a sense of companionship with life out-of-doors and an abiding love of nature. Let this latter be the teacher's criterion for judging his or her work. If nature-study as taught does not make the child love nature and the out-of-doors, then it should cease (Comstock, p. 2).

Comstock set nature study apart as not only different than, but in opposition to, drilling students based on facts and advocated that students construct knowledge based on direct observation and experience. These guidelines, among others, place the manual in a constructivist pedagogical framework. According to Pyle (2001), it “became one of the most universal texts in the American classroom, and it was not the only one of its kind” (p. 19).

The Dust Bowl was a series of dust storms causing immense ecological damage to prairie lands in the United States throughout the 1930s. Caused by decades of extensive farming without crop rotation or other techniques that prevented erosion, compounded by severe drought conditions, the Dust Bowl produced great human suffering for the people of Great Plains states such as Oklahoma, Kansas, and parts of Texas. Ultimately, over two million people were

displaced and countless others died due to health complications arising from exposure to dust or malnutrition (Dailey, 2007).

In the midst of the Great Depression, the Roosevelt administration responded with a number of initiatives to the ecological and economic crises precipitated by the Dust Bowl. The Soil Conservation Act, passed in 1935, contributed to the development and dissemination of conservation education to the nation's farmers. That same year, Wisconsin became the first state to pass a Conservation Education Statute mandating that teachers of science and social studies have knowledge of conservation of natural resources (Engleson, 2008). The statute required that public elementary and high school students be instructed in conservation as well. Implicit in these new initiatives was an acknowledgement and growing awareness of the interrelationship of human activity and the environment. In the early 1950s, the Conservation Education Association and the Association of Interpretive Naturalists were formed in order to support the growing number of educators working in the field of conservation education.

The Latter 20th Century: The Emergence of Environmental Education

Tracing a lineage that extends through the natural history and conservation education movements, modern environmental education was created in the 1960s and early 1970s. It was a time of immense social change in the United States advanced by various social movements: the Civil Rights movement, the anti-Vietnam War movement, the feminist movement, and the

broader environmental movement. Carson (1962), perhaps the best-known environmentalist of the twentieth century, studied the effects of pollution and pesticides on wildlife and the environment. Her work had an immense impact on public awareness and consciousness regarding human interaction (intentional and unintentional) with the natural world.

The popularity of Carson's work contributed directly to a social and political climate that saw the first Earth Day celebrated in 1970 and, later that year, the establishment of the Environmental Protection Agency. The initial Earth Day celebration involved over twenty million participants in United States (Nelson, 1980). Organized by Wisconsin Senator Gaylord Nelson and college student Dennis Hayes, the event brought together a broad-ranging coalition of interests and groups for a day of action and education. By 1973, a host of progressive environmental reforms became law including the Clean Air Act, Federal Occupational Health and Safety Act, Clean Water Act, Endangered Species Act, and the Resource Conservation and Recovery Act. In this broader context of social and political change, environmental education programs and curricula began sprouting throughout the country.

To support the new environmental education movement, the U.S. Congress passed the National Environmental Education Act in 1970. Though hampered by a lack of federal funding, the Office of Environmental Education provided schools nationwide with curricula, lesson plans, and teachers' guides. The OEE also advocated for the addition of environmental education content to science and social studies textbooks. The discipline began a process of professionalization

during this time. The National Association for Environmental Education, the first professional association for environmental educators, was founded in 1971 (Disinger, 2001). Professional journals dedicated to EE, such as *The Journal of Environmental Education* first published in 1969, began appearing as well.

Spring (2008) situated the burgeoning environmental education movement – sustained predominantly by conscientious teachers, students and activists at a grassroots level – as part of a paradigmatic shift from an industrial to a biosphere understanding of humans' relationship with nature. He identified Russian scientist Vernadsky (1998) as the thinker initially responsible for theorizing a "framework for integrating all life with an environmental system" and positing the interdependence of humans and the natural environment (Spring, p. 461). Tracing the concept's rise to international prominence at the UNESCO Biosphere Conference held in 1968, Spring described the joint International Union for the Conservation of Nature and Natural Resources (IUCN) and UNESCO meeting in Carson City, Nevada in 1970 as crucial to the history of environmental education. The IUCN/UNESCO meeting on "Environmental Education in the School Curriculum" issued the following definition for environmental education:

> Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture and his biophysical surroundings. Environmental education also entails practice in decision-making

> and self-formulation of behavior about issues concerning environmental quality (Palmer, 1998, p. 7).

Throughout the 1970s and 1980s a number of significant international conferences on environmental education were held. The world's first intergovernmental conference on environmental education was organized by the United Nations and convened in Tbilisi, Georgia in 1977. The principles, objectives, and goals set forth by the Tbilisi Declaration, which included the input of representatives of over eighty nations, made a clear connection between social and ecological processes and affirmed the mission of environmental education as providing the knowledge, skills, and experiences necessary for individuals to effect social and environmental change through action (Intergovernmental Conference on Environmental Education, 1977). Many of the guidelines created by the conference are still in use by environmental educators today. For example, Fisman (2005) noted that many contemporary place-based EE programs hold that awareness of the local environment is a necessary precursor to conservation and stewardship, a relationship first made explicit in the Tbilisi Declaration.

After being dismantled by the Reagan administration in 1981, the U.S. Congress recreated and passed the National Environmental Education Act in 1990. The act authorized the creation of an Office of Environmental Education within the EPA, environmental education and training programs, environmental education grants, and the founding of the National Environmental Education and Training Foundation (NEETF). The environmental justice movement, originating

in the late 1960s as a response to mainstream environmentalism's failure to resonate with communities outside of white middle and upper-class America, continued to expand and develop in the 1970s and 1980s (Cole, 2007). The predominant contemporary trends in environmental education can be traced to these two different, often contrasting, sources and perspectives.

Which Way Forward? Contemporary Trends in Environmental Education

The past twenty years have seen a rapid expansion in the quantity and variety of environmental education programs in the United States. Dominant views of the field have shifted from one of teaching about nature in the early 1970s to one of teaching through experiential fieldwork and values education in the1980s to one of action research and student-led problem-solving fieldwork in the 1990s (Palmer, 1997). Concurrent with the development of different methodological practices, debates about the goals of EE have flourished and a growing body of theoretical and research literature has blossomed. While some educators (Bowers, 2001; Gadotti, 2003; Kahn, 2008) have situated EE in the radical context of Freirean critical pedagogy as a socially transformative praxis, others have offered EE as a means to improving students' academic performance in the current climate of standards-based educational reform (Lieberman & Hoody, 1998; SEER, 1995a). If, as Spring (2008) contended, twenty-first century environmental education represents a radical challenge to the continuation of the industrial paradigm, which programs and perspectives

adopted by EE educators are most effective in addressing growing environmental crises?

Over the course of United States history, both Democratic and Republican administrations have eagerly linked the needs of business and the economy to the role of public schooling in our society (Spring, 2008). Following the publication of *A Nation at Risk* (NCEE, 1983), economic and political elites have pursued standards-based reform of public schools as one way to do so. The broadly stated and accepted goals for public education described in the report – that schools must train students to be successful, productive members of the workforce able to compete in an increasingly global economy – have changed little over the past twenty-five years. With the passage of the No Child Left Behind Act in 2001, the federal government (for the first time in U.S. history) created a standards regime for all public school students nationwide.

The State Education and Environment Roundtable (SEER) has been one of the primary organizations working to integrate environmental education with the standards-based reform movement (1995a; 1995b). Under the auspices of SEER, Lieberman and Hoody (1998; 2000; 2005) are frequently cited as having published key research connecting environmental education to improved student academic performance in a variety of disciplines, typically measured by increased standardized test scores and reduced discipline and classroom management problems. Federal agencies such as the National Environmental Education & Training Foundation have applauded the mainstreaming of environmental education in the nation's schools and seek to further the cause of

using the environment as an integrating context for learning (EIC) based on research published by SEER (Glenn, 2000). The EIC approach to EE encompassed the following practices and attributes: interdisciplinary, hands-on/experiential learning that is often problem-solving or project-based, aimed at developing understanding, knowledge and appreciation for the local community and natural surroundings (Lieberman & Hoody, 1998). The research supporting the efficacy of EIC in promoting student performance is based on schools that have adopted EE as the central focus of their academic programs.

A growing number of environmental educators and theorists have advocated an alternative, even oppositional path for environmental education. Bowers (1995; 2001) and Orr (1994) have played pre-eminent roles in advancing a radical critique of the goals of modern education from an ecological and social justice framework. They identified and questioned the connections between education and the continuation of an unsustainable and unjust economic and sociopolitical order. Their efforts to reveal the hidden curriculum – the underlying myths and assumptions – operating in traditional educational practices laid bare the education system's support of an industrial paradigm that has produced social inequality and environmental destruction.

Bowers' (2001) concept of eco-justice pedagogy closely resembled the ecopedagogy developed by Gadotti (2003) and Gruenewald's (2003b) critical pedagogy of place. Their theoretical stance began with the notion that "there is an incompatibility of principles between sustainability and capitalism" (Gadotti, p. 3). The goals of environmental education, therefore, necessarily included

providing knowledge and experiences that allowed students to challenge the foundations – both physical and ideological – of the current industrial capitalist system dominating the global economy. Nothing less than a complete transformation of our cultural, economic, and social systems could stop environmental destruction and promote equality, social justice, and sustainability. Additionally, though resting on a system-wide critique, these theories utilized Sobel's (1998; 2002; 2004) work on place-based education to explore how students could be empowered to act for social change in their local ecosystems and communities. However, at the time of this paper's writing, no trace of EE programs inspired by or based on these radical theorizations of EE could be found in the research literature.

Summary

While environmental education as a distinct field did not emerge until the late 1960s, its roots can be traced to the turn of the 20th century with the emergence of three educational movements whose influences are still felt today — nature study, conservation education and outdoor education. Over the past three decades, however, the limited definition and practice of nature education gave way to the much broader field of environmental education, often abbreviated as EE. Contemporary trends in EE, despite what are often overlapping methods, provided oppositional frameworks in which to theorize their practice and goals. Whether as a means to promote student academic achievement or as a means to cultivate agency toward radical social change, a growing body of research on environmental education exists. The next chapter

provides a critical review of research literature intended to determine the effectiveness of contemporary environmental education programs in promoting environmentally sustainable beliefs and actions in their student participants.

CHAPTER THREE: CRITICAL REVIEW OF THE LITERATURE

Introduction

Chapter one indicated the scope and scale of environmental and social crises facing the earth and its inhabitants. Environmental education (EE) represents one possible strategy for addressing the global, socioecological challenges posed by critical issues such as vanishing biodiversity and anthropogenic climate change. Public schools are sociocultural institutions uniquely situated to deliver widespread, transformative environmental education programs and curricula. Whether or not schools are able to pursue that promise rests in part on the outcome of the debate between proponents of environmental education and opponents who argue EE detracts from schools' primary mandate – a more narrowly defined academic agenda.

Chapter two explored the history of environmental education in the United States. While environmental education as a distinct field did not emerge until the late 1960s, its roots can be traced to the turn of the 20th century with the proliferation of three educational movements whose influences are still felt today – nature study, conservation education and outdoor education. It examined the lineage of environmental education through broad historical and social contexts and described contemporary trends in EE philosophy and practice.

Chapter three presents a critical review of current research on environmental education. The research discussed in this chapter evaluates the effects of various environmental education programs and interventions on: children's perceptions, use, and valuation of local environments; children's

environmental knowledge, values, and actions; and children's academic performance. Each of the studies are summarized, with analysis and conclusions provided. The research is reviewed in order to determine the effectiveness of contemporary environmental education programs in promoting environmentally sustainable values and actions in their student participants, along with additional information relevant to designing more effective EE programs and curricula in the future.

Perceptions, Use, and Valuation of Local Environments

The initial set of studies in this section explicated the link between students' familiarity with local environments (natural and constructed) and how likely they were to use them for recreation, play, and how it impacted their independent mobility. Timperio, Crawford, Telford, and Salmon (2004) examined associations between perceptions of local neighborhoods and walking and cycling among children. Similarly, Tandy (1999) documented factors influencing the nature and location of children's play, including (most importantly to the present study) youth and parental perceptions of local parks and streets. Veitch, Bagley, Ball, and Salmon (2004) again examined the nature and location of children's play with particular emphases on key social and safety factors including individual preferences and perceptions of play spaces.

Timperio, Crawford, Telford, and Salmon (2004) conducted a quantitative, survey-based study of families on the relationship between perceptions of the local neighborhood and children's independent mobility. Two hundred ninety-one families with children aged 5-6 years (representing a 27% response rate) and

919 children aged 10-12 years (representing a 44% response rate). Families of children aged 5-6 and 10-12 years were recruited from 19 public primary schools in high SES (n = 10) and low SES (n = 9) areas in Melbourne, Australia.[1] Schools were selected using stratified random sampling proportionate to school size. Active consent was sought and only those families who returned consent forms were eligible to participate.

Two self-completion questionnaires were developed. The first was administered to parents and the second was administered only to children 10-12 years old. Parents completed their questionnaire at home, while 10-12 year-old children completed their questionnaire in class with research staff present to guide completion of each question. The 2-week test-retest reliability of several key items was established in a separate study of 97 parents of 5-6 year-olds and 156 parents of 10-12 year-olds. One-week test-retest reliability of the child self-report was established among one hundred thirty-eight 10-12 year old children.

1.) Parents reported their 5-6 year old child's usual walking or cycling to local destinations and their perceptions of their neighborhood.
2.) Ten- to twelve-year-olds were asked their perceptions of traffic, strangers, road safety and sporting venues, and their perceptions of their parent's views on these issues.

Responses to the questionnaires were recorded by participants on a seven-point Likert-type scale.

The authors conducted multivariate analyses of the survey responses, including Tukey HSD post hoc tests, Pearson's chi-square tests of significance,

and logistic regression analyses to determine the connection between specific variables. The analyses revealed that children's perceptions of their local neighborhood varied according to SES. For example, boys of low SES were more concerned about dangers presented by traffic than boys of high SES (30.7% vs. 17.8%, $p = .028$) and a greater proportion of low SES girls were concerned about stranger danger than high SES girls (58.3% vs. 45.1%, $p = .009$). Despite these and other safety concerns, among 5- and 6-year-old children, 77.3% of boys and 63.4% of girls reported walking or cycling to local destinations at least three times each week. Among 10- to 12-year-old children, 82.2% of boys and 75.3% of girls walked or cycled to local destinations at least three times per week. The evidence clearly showed that perceptions of the local environment impacted use and independent mobility, and that perceptions of the local environment were significantly influenced by participants' SES.

The large sample represents a broad demographic cross-section of sex and SES, and includes children in two key age ranges: 5-6 ($n = 1093$) and 10-12 ($n = 2096$). However, sample selection was nonrandomized as participants self-selected into the study. This may have biased the results. Data analysis on the significance of participant responses and the relationship between variables was extensive. The study is externally validated by similar outcomes of other studies in this section.

Tandy (1999) conducted a mixed method analysis of survey questionnaire responses regarding youth ($n = 421$) and parental ($n = 165$) perceptions of local outdoor spaces. Subjects were chosen from suburbs of New Castle, Australia

that were representative of the greater region of Newcastle. The selected area did not exhibit any extremes of residential or social differentiation, such as class or ethnic and family status. The total population of the study area was 30,362. 6.6% were born overseas and 0.9% were of Aboriginal or Torres Strait Island descent. The percentage of two-parent families was 53.3%. The percentage of unemployed as a proportion of the total labor force was 10.3%, with 29.5% of females aged 25-44 participating in the labor force. Most (74%) of the parents who replied to the questionnaire were in the 31 to 40 year age cohort. The age range of children participating in survey was five to twelve. Demographic data on the specific participants beyond gender was unavailable, calling into question the study's transferability claims.

Two structured questionnaires were administered, one for children and one for a parent of each participating child. The children's questionnaire consisted of four sections. The first included outdoor play, access to outdoor play spaces, time spent playing outdoors, and independent mobility to outdoor play spaces (such as riding a bicycle to a park). The second section questioned children's use of technology, especially regarding television and video games. The third included questions intended to determine the SES of the children's families. A similar questionnaire was taken by parents, and the results from both samples were compared in order to answer the researcher's questions on the changing nature of play and access to outdoor play spaces. The fourth and final section, an open-ended drawing activity, was based on observation and interpreted qualitatively.

Besides issues of transferability described earlier, the methods of this study were extremely unclear. Beyond choosing a geographic area meant to be demographically representative of the broader urban region of Newcastle, the author provided no information on how samples were chosen, nor how questionnaires were created and administered. The author raised concerns about the accuracy of parents' recollections of their childhoods and its impact on the validity of comparing student and parent questionnaire results. Though the study built on an admittedly limited body of research on children's spatial and environmental awareness and their use of urban space, its broad claims appear unfounded given the points of methodological critique raised here.

Veitch, Bagley, Ball, and Salmon (2006) examined parents' perceptions of where children choose to play and why in a qualitative, interview-based study. Parents (n = 78) from low (20), mid (35) and high (23) socio-economic areas in Melbourne, Australia. Subjects volunteered by responding to notices placed in school newsletters, and "snowball techniques" were used to recruit additional parents. All parents who participated were required to have at least one child attending the school in grade one through grade six. This was the only selection criterion that determined suitability for participation. Over 90% (70/78) of the parents interviewed were mothers, 79% were married, and 88% had either two or three children. The average age of the child about whom the parent responded was 8.3 years ($\pm$ 2.1). No information on response rate was given.

Face-to-face interviews were conducted by one of four trained female researchers. The interviews lasted approximately 30-45 minutes and were

conducted in a quiet room at the school where the participant's child attended. The interviews were recorded and a $20 gift voucher was given to participants at the end of the interviews. All interview data were transcribed verbatim. Analysis of data was based on an examination of participants' responses to each question. Two researchers reviewed transcripts to generate a series of coding categories and sub-categories based on the aims of the study and the themes that emerged. A random sample of ten transcripts was cross-coded to check for inter-coder agreement. These codes were then applied to all transcripts using the qualitative software package NVivo. This package was used to facilitate analysis of data and themes, and identification of relevant quotes.

Similar to Tandy (1999) and Timperio et al. (2004), the most frequently reported factor influencing where children played was parent concerns regarding their child's safety (94%). Oft-cited factors included concerns about traffic, strangers, and availability of parks or other spaces, as well as children's attitudes toward outdoor play. In response to the question, "Is your child a user of public open space?", differences among respondents varied significantly according to SES: only 52% of low SES responded yes, while 77% and 65% of middle and high SES responded yes.

The ecological model utilized in this study took a broad approach by including both individual and environmental factors that contributed to behavior, identity formation, and use of space. Along with interviews, this qualitative design provided rich, complex information on participant perspectives. Although the sample size was small (n = 78) the participants represented a good

socioeconomic status cross-section (but no other demographic information was provided). Even though the problems associated with self-reported environmental behavior make the credibility of data difficult to assess, the findings are externally validated by other studies reviewed in this section as well as similar, earlier studies conducted in the United States and Western Europe (see, for example, Blakely, 1994; Valentine & McKendrick, 1997).

The second set of studies in this section explore the connection between students' familiarity (e.g., knowledge, experience, or affect) with local environments and how much they valued and cared for them. Evans, Brauchle, Haq, Stecker, Wong, and Shapiro (2007) evaluated young children's environmental attitudes and behaviors in an effort to determine the extent to which pro-environmental attitudes predict pro-environmental behaviors. Kuhlemeier, Berg, and Lagerweij (1999) analyzed the results of a Dutch nation-wide survey of students' environmental knowledge, attitudes, and behavior to develop a better understanding of the connection between those elements. Fisman (2005) related the implementation of an environmental education program to students' growing awareness of their local biophysical environment. Lindemann-Matthies (2005; 2006) investigated the relationship between children's knowledge of common, local plants and animals and their affinity toward them. Vaske and Kobrin (2001) described how an individual's attachment to place, a process of meaning-creation fostered by emotional connection, effects his or her environmentally responsive behavior. Finally, Chawla (1999) interviewed adult environmentalists in order to determine the sources of their

environmental commitment, such as formative childhood experiences in nature.

Evans et al. (2007) conducted a quantitative study of first- and second-grade children's (n = 100, M = 6.8 years) environmental attitudes and behaviors. The participants were recruited through public schools in rural upstate New York. The children's families returned an initial interest postcard (sent home from school with children), after which researchers explained the research program in full before parents committed their children to participate. The sample was evenly split between males and females and ninety-two percent of participants were white. Seventy-six percent of the children were from well educated (those who had mothers who were college graduates) families and the median annual income of participants was between $60,000 and $75,000. The authors noted that the sample was not demographically representative of the population of rural upstate New York.

The authors developed a series of three games in accordance with the research-based conceptual model of environmental attitudes and values called the New Environmental Paradigm Scale (NEP). The NEP has shown excellent reliability and validity as well as high internal consistency across multiple heterogeneous samples (see, for example, Dunlap et al., 2000). The three attitudinal games were based on the four dimensions of the NEP framework: anthropocentrism, limits to growth, the balance of nature, and concern about environmental catastrophe. In addition to building their research instruments on the NEP model, the authors separated environmental attitude assessment with environmental behavior assessment. A fourth and final game measured eight

environmental behaviors, such as recycling, by having students jump a distance on a line to indicate the frequency of that behavior. One of a team of three trained research assistants visited children in their homes to play games with them and measures were taken to ensure comprehensibility.

The researchers found no gender, age, or ethnicity differences in the results, so that all of the data across these variables are collapsed in the findings. On environmental attitudes scale, internal consistency (Cronbach's alpha) for eleven items was .69. Three items were eliminated from the final scale scoring due to unreliability. Test-retest reliability over a 3-week period was high for the children's environmental attitudes scale, $r = .89$, $p < .01$. The results are summarized in Table 3.1:

Table 3.1: Frequency Distributions of Environmental Attitudes

	% Scoring 1 (High on NEP) Versus 0 (Low on NEP)
Board game	
Play outside/watch television	75
Draw on both/one side of paper	61
Rake leaves/leaf blower	60
Felt board construction	
Nature fragile/nature resilient	52
No use/use of chemicals to kill garden pests	62
Older, better made/new short-lived teddy bear	75
Worry thermometer	
Worry/no worry about air pollution	79
Worry/no worry about water pollution from industrial dumping	82
Worry/no worry about inadequate/poor resources with overpopulation of deer	85
Worry/no worry about garbage/waste too near residential area	67
Worry/no worry about destruction of park space for development	80

The environmental attitude scale scores varied from 1 to 11 across the full range of the scale, with a mean of 7.78 and a standard deviation of 2.06. The median score was 8 with little skewness (-.76).

For the behavior scale, reliability and validity were assessed using a Rasch (see, for example, Bond and Fox, 2001) measurement model. All eight behavior items were retained because, together, they yielded the most reliable Rasch scale with a separation reliability coefficient of .49. However, the researchers noted, .49 fell below an ideal separation reliability value of .60 or higher that would validate the instrument's reliability. Most of the children performed most of the positive environmental behaviors to at least some extent. Scores varied from 9 to 23 of a possible range of 8 to 24, with a mean of 17.55 and a standard deviation of 2.75. The median score was 18, and skewness equaled -.37. Test-retest reliability over a three-week time period yielded a more satisfactory score of $r = .70$, $p < .01$.

Evans et al. (2007) assessed the validity of their instruments in a variety of ways one of which, of particular note, being their assessment via experience in an outdoor nature education camp. Scale scores for the instruments were compared pre- and post-camp. None of the first- and second-grade children in this validity assessment were in the major study sample, and no other demographic data was provided. However, the camp experience was found to have significantly changed participants' environmental attitudes from Day 1 ($M = 7.27$, $SD = 2.36$) to Day 5 ($M = 7.95$, $SD = 2.42$), $t(40) = 1.90$, $p < .03$. No significant change in environmental behavior was found, though. Though these

findings regarding the validity of the instruments are of interest to this paper's overarching question, the instrument-validity study is not explicitly referenced by Evans et al. (2007) and could not be located for further review.

After presenting further data analysis bolstering claims of the internal consistency and temporal stability of the results (demonstrating that the subjects could reliably report on environmental attitudes and behaviors), the authors discussed the implications of their findings. Beyond noting that young children (ages 4 to 8) hold moderately high environmental attitudes (M = 7.78/11) and tend to behave in a manner that is ecologically responsible (M = 17.55/24), one of the most obvious and noteworthy results of the study is the lack of correlation between environmental attitudes and behaviors. The authors speculated that behavioral options for engagement in proenvironmental behaviors may be limited for young children meaning, essentially, that their ability to act in accordance with their values may be hampered by their circumstances (e.g., lack of purchasing power). Their suggestion of finding a more varied array of survey items that are within a young child's capability to choose would improve the validity of the environmental behavior survey results. Repeating the study with a more demographically and geographically diverse sample may change the results and would provide further insight into young children's environmental attitudes and behaviors, and the relationship between them. The study's major contribution to the literature is the authors' successful attempts to develop instruments with high degrees of internal consistency and reliability.

Kuhlemeier, Berg, and Lagerweij (1999) conducted an analysis of a quantitative, survey-based study of over 9,000 Dutch secondary school students' (age +/- 15 years) environmental knowledge, attitudes, and behaviors. The survey was developed and administered as part of the National Assessment of Educational Achievement Program in the Netherlands. A two-staged cluster sample was drawn. In the first stage, 206 schools were selected, with a sampling probability proportional to the number of ninth-grade students. In the second stage, students were sampled within schools. Using a matrix sampling design, the authors randomly assigned the environmental instruments to the students. Of the total of more than 9,000 participants, 39% were higher general education students, 40% were intermediate general education students, and 21% were lower vocational training students. The student population sample contained slightly more girls (52%) than boys (48%).

Three survey instruments were designed to measure (1) environmental knowledge (R = .73), (2) environmental attitude and willingness to make sacrifices (R = .85), and (3) environmentally responsible behavior (R = .71). The survey instruments were developed based on previous quantitative research that is documented in the study. The environmental knowledge survey consisted of eighty true/false items that, after field testing, could also be answered with the choice "I really do not know." The environmental attitude and ERB surveys each contained twenty Likert-type items. The ERB survey was purposively designed to include only discrete, observable behaviors and did not attempt to deduce participants' underlying behavioral motives.

The authors analyzed the results using a multivariate multilevel model using the ML3 software package. The first part of the authors' analysis was intended to demonstrate that the environmental knowledge, attitudes, and behavior of ninth-grade students in secondary education can be measured in a reliable way and that the validity of survey instruments was sound. For the purposes of analysis, the authors broke the survey on environmental attitudes and willingness to make sacrifices into two instruments. A two-level variance component model, with students nested within schools, was fitted to the data. After deriving mean scores for participant responses, the authors used covariance matrices to measure the correlations between survey instruments at the between-school and between-student levels.

The results of the environmental knowledge survey showed that the average student selected the correct answer for 18/30 items, while 15% of students scored above 23/30 and the lowest 17% of students scored no higher than 13/30. The mean score for degrees of difficulty on the items was .60. The degree of attraction for the survey response "I really do not know" was .18 on average across all thirty items. The results were similar to those expected if participants had responded randomly, suggesting that the participants' environmental knowledge was poor.

On the environmental attitudes and willingness to make sacrifices surveys, a mean score of 25 represented a neutral participant position. The mean score for environmental attitudes was 31 and the mean score for willingness to make sacrifices was 29, from which the authors concluded that the average student

had a positive environmental attitude. After separating the distribution of the scores into three categories, researchers found that 57% of students had positive to very positive environmental attitudes, 42% neutral, and 1% negative. For willingness to make sacrifices, the distribution was 35% strong to very strong and 60% neutral.

The results of the ERB survey showed a mean score of 7 (on a scale of –20 to 20, 0 being neutral). The distribution of responses ranged from 4% negative (-4 or lower), roughly 20% neutral (-3 to 3), nearly 50% environmentally friendly (4-10), 25% extremely environmentally friendly (11-18), and about 4% of students achieved the highest rating (19-20).

The correlations between environmental knowledge and environmental attitude ($r = .26$), willingness to make sacrifices ($r = .21$), and environmentally responsible behavior ($r = .20$) were very low with a significance of $p < .001$. In other words, students with greater environmental knowledge did not report attitudes or behavior significantly different from those who scored lower on the environmental knowledge survey. A substantial relation between knowledge of environmental problems, on the one hand, and attitudes and behavior, on the other, could not be demonstrated in the study. The tests of significance for positive, direct correlations between environmental knowledge and attitudes/behaviors on the between-schools analysis yielded a score of $p = .986$, nullifying the findings. However, the lack of correlations between environmental knowledge and attitudes/behaviors on the between-students analysis was significant ($p < .001$). Additionally, willingness to make sacrifices was more

strongly connected with environmental attitude (r = .54) than with environmental knowledge (r = .21) and environmentally responsible behavior was more strongly connected with environmental attitude (r = .36) than with environmental knowledge (r = .20) on the between-students analysis.

Therefore, the findings suggested possible directions for the content and structure of EE programs, lending credence to the position that experiences in/with nature that cultivate an affective (and not just knowledge-based) relationship or attitude may be more important in promoting environmentally responsible behavior. The authors did not reach this conclusion. After going to such lengths to prove the validity of their survey instruments, it was telling to read the authors' concluding remarks which suggested the lack of correlation demonstrated between knowledge and attitudes/behaviors may be due to the inapplicability of questionnaires as a means to measure behavior. This conclusion was not supported by the data provided.

In a mixed method action research study, Fisman (2005) explored the impact an environmental education program had on students' (n = 47) awareness of their local environment. Beyond the age of the respondents (3^{rd} – 5^{th} grade), little demographic information on the sample is presented, though the author did include general demographic information for the two schools in New Haven, Connecticut where the data was gathered and speculated on students' socioeconomic status (SES) by correlating respondents' addresses to U.S. census data for mean household income in a given neighborhood. The lack of demographic data and small sample size call into question the study results'

transferability to other populations.

Students in the study participated in the *Open Spaces as Learning Places* program, completing both pre- and post-intervention test questionnaires, maps of their neighborhoods, and oral interviews. Using a series of paired *t* tests, Fisman found that four of five mapping variables (scope, natural features, tree, and built features) showed significant ($p < .01$) positive change but reported a less significant ($p < .08$) positive change on students' test questionnaires. When analyzing the results, the author acknowledged the research design flaw of lacking a control group to compare how the variables may have been affected by other factors, such as the passage of time or simply taking the test again without the specific intervention. Without a more fully developed quasi-experimental design in which these sorts of independent variables are controlled and/or accounted for, the credibility of the results – attributing students' increased environmental awareness to the intervention – are promising but largely speculative.

Lindemann-Matthies (2005; 2006), in quantitative statistical analyses of survey questionnaire responses, collected data on students' preferences for local plant and animal species, and how their preferences were shaped by the environmental education curriculum *Nature on the Way to School*. More than 3000 children (8-16 years old) from 166 primary and secondary school classes and 117 teachers participated in the study. The questionnaires were sent to 525 schools in Switzerland. The pretest questionnaires were returned by 38% and the post-test questionnaires by 31% of the schools. The data were collected during a

5-month period (March-July 1995). Only classes that participated in both the pretest and post-test were included in the analyses (248 classes from 146 schools). The experimental group consisted of 166 classes and the control group of 82 classes. Although the teaching material was mainly designed for primary schools, some secondary schools also participated in the program (in Switzerland, students start secondary school as seventh graders). The mean age of children in the participating classes ranged from 8 to 16 years, but the largest group were of very similar age (10.6 years versus 10.9 years, $p = 0.39$). The proportion of girls was 51% in the control group and 49% in the experimental group. Data on the time spent on the program (number of lessons) were available for 132 classes.

The EE intervention was designed to increase children's awareness of plants and animals in their daily lives, promoting interest in and tolerance of local species. Post-treatment data revealed that a greater proportion of children in classes of the experimental group than in those of the control group (11.4% versus 2.6%) increased their appreciation of wild plants, in particular wildflowers. In contrast, children's appreciation of decorative or garden plants, wild animals and pets was not affected by participation in the program. The residual variation among classes within schools was significant. Because of the hierarchical analysis, this result showed that there were differences among the individual classes in preference for species that could not be explained by differences among schools, mean age of children, or effects of the EE program. The study's author attributed these differences to variation among teachers administering the

program. One particular variable of note was the amount of class time devoted to lessons from the program, which ranged from 1-60 hours (with an average of 17).

In a quantitative statistical analysis of survey questionnaire responses, Vaske & Kobrin (2001) researched the effect of participation in an outdoor environmental work program on youth's attachment to place. Data for this study were obtained from an on-site survey distributed to youth, 14-17 years of age, who participated in local, natural-resource-based work programs. Three youth programs of similar size, work tasks, and length of employment were selected. Surveys were distributed after the youth had completed a 5- to 7-week work program. Virtually all program participants were included in the sample (n = 182; response rate = 95%). Those not included in the sample were not in attendance on the day the survey was distributed. No demographic information beyond age were given for the sample population, making the study's generalizability unknown.

Three concepts were examined in the study: place dependence, place identity, and environmentally responsible behavior (ERB). The results were self-reported by participants on a series of five-point Likert-type scales. The authors measured the internal consistency of the variables using Cronbach's alpha reliability coefficients, postulating that place identity mediated the relationship between place dependence and responsible behavior. This hypothesis was verified by the results: place dependence influenced place identity (Cronbach's alpha = .88, $p < .001$, $R^2 = .77$), and place identity was significantly related to ERB (Cronbach's alpha = .63, $p < .001$, $R^2 = .40$). Overall, the model suggested

that encouraging an individual's connection to a natural setting facilitates the development of general ERB. Though the reliability and significance of the data were confirmed, the authors made it clear that the study did not demonstrate a direct causal relationship between increased place identity (fostered by participation in the outdoor environmental work program) and ERB. In order to do so, a pre/post experimental design would be needed.

In a qualitative, phenomenological study Chawla (1999) interviewed 30 environmentalists in Kentucky and 26 in Norway (35 men, 21 women) to see what types of life experiences influenced their commitment to a wide range of environmental issues, from wilderness protection to sustainable urban planning. The author conducted structured, open-ended interviews (1-2 hours in length) with relatively well-known environmental figures in each geographic location.

In keeping with the participants' status as experienced activists, about 60% in each country were between the ages of 30 and 49. The remaining 40% of the Kentucky sample, and 27% of the Norwegian sample, were 50 or over. In terms of education, all but 4% in Kentucky and 15% in Norway had gone beyond secondary school; 77% in Kentucky and 38% in Norway had continued their education beyond a basic university degree to a master's or doctorate. Men were more likely than women to have pursued an advanced degree, even though women were more likely than men to have a professional parent and less likely to have a parent who was a farmer or skilled or semi-skilled laborer. Overall, the samples were Caucasian, well educated, and middle class. This composition reflects the structure of environmental leadership at each location and the

relative homogeneity of the populations. In Kentucky, only 8% of the population in the 1990 census were non-White or Hispanic. In Norway, only 2% of the 1994 population were born in Africa, Asia, or Latin America.

Interview results were transcribed and then analyzed in order to categorize participant remarks into distinct sources of environmental commitment. Nearly all participants attributed their commitment to several sources. At each site, both the mode and average number of significant sources per person was four, with a range of one to six (80% gave three to five responses). This result is consistent with similar studies, which have also showed multiple sources of environmental concern (Chawla, 1998). Most people described childhood as the foundation of their relationship with the environment. Childhood predominated in importance both in terms of the number of types of formative experiences with which it was associated and how frequently it was mentioned. Only three respondents (5%) did not begin their explanations of their commitment with childhood.

The leading explanations of commitment were the experience of natural areas and the influence of family members who directed attention to the value of the environment or the importance of social justice (77% of the combined sample in each case). In all cases in Norway, and in 22 of 26 cases in Kentucky, formative places were childhood places. Other significant contributing factors included experiences as part of an environmental organization (55%), negative experiences such as exposure to pollution (39%), and educational experiences like inspiring teachers or classes (38%).

Chawla's (1999) discussion of the findings was theoretically nuanced and dynamic, drawing on disciplines such as phenomenology, psychology, and historiography. Though the findings were purely descriptive, lacking longitudinal design or a control group, the author argued the value of phenomenological research was its basis in "people's own understanding of their experiences and actions" (p. 23). In order to avoid an overly deterministic model of the development of responsible environmental behavior, Chawla argued that EE researchers must accept the limited potential to predict behaviors based on past experiences. Based on the findings, she called for a broad-based definition of environmental education that includes formal (in the classroom or the field), informal (less structured time in nature), and nonformal (within groups or organizations) learning in order to provide as many opportunities as possible for increasing children's environmental exposure and awareness.

The initial three studies in this section documented the link between students' familiarity with local environments (natural and constructed) and how likely they were to use them for recreation, play, and how it shaped their independent mobility. The next six studies explored the connection between students' sense of familiarity (knowledge, experience, or affect) or identification with local environments and how much they valued or cared for them. The final study presented reflections by adult environmental activists regarding the sources of their commitment to environmentally responsible behavior. The next section contains studies of diverse environmental education programs, experiences, and curricula and their impacts on students' environmental

knowledge, values, and behavior.

Environmental Knowledge, Values, and Actions

The studies in the second section examined a wide variety of environmental education programs, implemented in and outside of the classroom, and their effects on participants' environmental beliefs, attitudes, and actions. In order to get a sense of EE research conducted before 1998, the author reviewed Zelezny's (1999) meta-analysis of classroom-based versus outdoor EE programs and their comparable effects on environmental behavior. An American Institutes for Research (2005) study documented the link between student participation in an outdoor education program, their perspectives on the use of natural resources, and their stewardship of the environment. Farmer, Knapp, and Benton (2007) explored the connection between an educational field trip to Great Smoky Mountains National Park and its long-term effects on students' ecological and environmental knowledge and attitudes. Haluza-Delay (2001) investigated the impacts of a twelve-day outdoor education trip on participants' conceptualization of nature and their motivation to care for the environment. In a similar phenomenological study, Knapp and Poff (2001) collected interview-based data on the effects of an interpretive outdoor field trip on students' environmental knowledge, attitudes, and behavior. Mogensen and Nielsen (2001) examined the success that EE in Danish public schools has had developing students' action competence regarding environmental issues and problems. Palmberg and Kuru (2000) researched the role of outdoor education in the development of students' self-confidence and agency. Dettman-Easler and Pease (1999) evaluated the

effectiveness of residential environmental education programs in fostering positive attitudes toward wildlife. Gunderson (2001) investigated the effects of a U.S. Forest Service EE curriculum on K-8 students' knowledge, attitudes, and beliefs about wilderness. Mayer-Smith, Bartosh, and Peterat (2007) researched the impact an intergenerational food growing program had on children's environmental consciousness. In a small but conceptually challenging study, Finally, Volk and Cheak (2003) evaluated the broad impacts a school-based environmental education program had on students, their parents, and the surrounding community.

Zelezny (1999) conducted a quantitative meta-analysis of environmental education programs (n = 18), comparing those in and outside of school classrooms, to gauge their effects on environmental behavior. Data were collected from the years 1971-1996 and provide an interesting summary of research that falls outside of the scope of the current paper (1998-2008). The author limited her research to studies available through the Psychological Literature Abstracts (Psyc Lit) and Educational Resources Information Center (ERIC) online databases. Zelezny used the following key word search terms to frame a sample of potential studies: environment, ecology, education, behavior, change, environmental education, and environmental behavior.

The author reported developing a way to quantify the tolerance for null results in which, after recording the exact p values for each study in the review, she used a normal distribution table to convert each p value to a z score. The author then summed standard normal deviates (zs; z_{total} = 28.575) and used them

to calculate Rosenthal's equation to find the tolerance for null results. According to these results, the estimates indicated that the sample under review was not significantly biased.

Studies were reviewed, summarized, and organized using a broad range of criteria including: effect on environmental behavior in traditional (classroom) versus nontraditional settings; effect on environmental behavior in active versus nonactive interventions; and methodological rigor of the studies. Beyond describing the interventions and participants, in order to conduct these analyses Zelezny classified EE programs in each study with a system of + and – signs.

Active interventions (+) were defined as those requiring hands-on participant involvement (e.g., creating a garden) while non-active interventions (–) required the participant to receive information passively (e.g., a lecture). All dependent variables (effects on behavior) measured were reported including actual behavior, reported behavior, and inferred behavior depending on the study. The effect of the interventions was defined as the effect size (point biserial correlation coefficients; *r*) according to each study's reported measures of significance (*t*, *F*, or chi-square). Additionally, studies were compared according to methodological criteria. Studies were assigned a (+) if they met the criteria for methodological rigor (random assignment, pre-intervention assessment of group equivalence, inclusion of a control group, use of pretest-posttest design, report of test reliability, use of blind raters, and inclusion of follow-up procedures) and a (–) if these criteria were not met.

Overall, the author found that EE interventions in classrooms more effectively improved environmental behavior than interventions outside of classrooms. All classroom intervention studies (*n* = 9) reported improved proenvironmental behavior. Among studies in nontraditional settings, four of nine (44%) reported improved proenvironmental behavior and five of nine (56%) reported no effects. The average treatment effect (*r)* for educational interventions in the classroom was .65 versus .27 for interventions in nontraditional settings. Interventions that actively involved participants (14 of 18, 78%) were more effective (*r* = .55) than interventions that did not (*r* = .18). A correlation, *rpb*(18) = .40, was found between the estimated intervention effect and participant involvement. Eight of 18 (44%) of the studies (four classroom-based, four non-traditional) were found to have notably stronger research methods (i.e., more + than – signs). Finally, 16 of 18 (89%) of the studies measured self-reported or inferred changes in environmental behavior while only 2 (11%) measured observed behavioral changes.

As the author noted, the quality of studies in this meta-analysis varied widely and included an extremely heterogeneous mix of subjects, methods, and measures. Therefore, it is difficult to base any strong conclusions on the findings of the study. It is important to consider that 8 of 9 classroom interventions (89%) included active participant involvement while only 6 of 9 non-classroom interventions (67%) included active participant involvement, a difference that – given the correlation found between intervention effect and participant involvement (*rpb*(18) = .40) – may have shaped the findings of overall

intervention effectiveness more than the setting in which they took place. Studies completed in the years following this meta-analysis have provided further insight (and more explicit data) on the effectiveness of different EE programs in promoting proenvironmental behavior with more attention to the structure and content of the interventions.

The American Institutes for Research (2005) conducted a mixed method study consisting of surveys, interviews, and site-based observations in order to determine the effects of outdoor education programs on students' personal and social skills, environmental values, and knowledge/understanding of science concepts. The subjects were sixth-grade students (n = 255) from four elementary schools in California, mostly Hispanic children (ranging from 69 percent to 89 percent of the student population) with a high proportion of English language learners (32 percent to 66 percent of students). Eighty-one to 100% of the children in each school qualified for the free and reduced price lunch program.

The study utilized a delayed treatment design whereby assessments of students who participated in an outdoor education program (treatment group) were compared to assessments of students whose participation in the program had not yet occurred (control group). Assessments were based on surveys administered to students, interviews conducted with parents, students, and teachers, and on-site observations of students participating in the outdoor education program. The data most relevant to this section, addressing the question of environmental perceptions, attitudes, and behaviors, were gathered through parent and student surveys where respondents addressed statements

with a rating on an eleven point Likert-type scale. Three rounds of surveys were conducted in order to gauge the treatment's short and long-term effects.

Survey results were recorded as electronic data files. Scales for five social and personal constructs, three environmental attitude scales, and an overall science score, were developed from individual survey items. The reliability of these constructs (scales) was assessed by calculating Cronbach's alpha, which measures the extent to which the scale items are measuring a common, underlying construct. Based on an analysis plan developed for the study, two independent sample t-tests were used to detect statistically significant differences between various student groups and subgroups (e.g., treatment versus control groups, male versus female, Hispanic versus non-Hispanic students). Paired-sample t-tests were employed to examine significant gain scores within groups. Similar analyses were conducted for survey data from parents and teachers. The criterion used for statistical significance was $p<.05$.

The survey results formed the core of research findings, while the interviews and observations lent qualitative texture to provide a more holistic understanding of how the treatment impacted participants. The findings most relevant to this section dealt with students' perception of the environment and how students' environmental values (such as stewardship and conservation) may have changed due to the intervention. According to student assessments gathered immediately after program participation, the treatment group showed a significant gain in concern about conservation ($p<.05$), although it was not significantly higher than the control group. While participating students showed a

greater gain in their attitude toward science (5.81 percent) compared to students who did not attend the program (.64 percent), the difference between the two groups was not statistically significant. In addition, while the treatment group showed a decrease in environmental behaviors, it was not statistically significant compared to the control group.

The longer-term impacts of the treatment were even more nebulous. On student self-reports, the control group showed statistically significant declines in attitudes toward science (-.80 or -13.17%) and environmentally responsible behaviors (-.65 or -7.12%) while the treatment group showed no significant gains or losses in any of the three categories. According to parent reports, however, students who participated in the program had significantly larger gains in environmental behaviors (.90 or 9.42%) compared to children who did not attend the program. In other words, parents of children who attended outdoor school observed children engaging in positive environmental behaviors (e.g., recycling) at home, whereas a statistically significant finding was not observed for parents of the control group.

The qualitative and quantitative data paint fairly different pictures of treatment outcomes in this study. While it would be a mistake to ignore the qualitative data, interviews and observations which speak very strongly to the positive benefits of the outdoor education program on a wide variety of measures, it is also impossible to ignore the quantitative data collected through surveys that reflect a more ambiguous picture of the overall benefits to student participants. Additionally, the study did not utilize member checking to verify the

validity of the qualitative findings. The short-term gains for participants, while generally (2 of 3 categories) statistically significant, were not different enough from the control group to be comparably significant. The long-term effects, measured by responses on the third and final survey, showed only a lack of decrease in each category for the treatment group over the original pre-treatment survey; essentially, students' views were unchanged by the experience. The authors of the study believed the length of the treatment (five days) may not have been long enough to merit any long-term gains. Additionally, the authors suggested explicit efforts to link the outdoor education program and students' homes may be needed to solidify and sustain the program's effects.

In a qualitative, phenomenological study of one class's (n = 15) experience in the Great Smoky Mountains National Park, Farmer, Knapp, and Benton (2007) explored the trip's long-term impact on students' environmental knowledge and values. The participants, 92.4% Caucasian and nearly equal numbers of males and females, were fourth grade students from an urban, public elementary school in eastern Tennessee. Students participated in a one-day environmental education program during a field trip to the National Park that included hiking, ranger-led discussions, and activities designed to promote ecological and environmental awareness and knowledge.

The authors conducted in-depth (lasting between twenty and forty minutes), open-ended interviews with fifteen of the self-selected students who participated in the field trip one year after it had taken place. Interviews were participant-centered in the sense that the students controlled the direction of the interview,

including the subject matter and the range of topics discussed and received little to no encouragement from interviewers who mainly sought clarification and elaboration of student remarks. Each interview was transcribed verbatim and then analyzed in a three-step process whereby the authors used raw interview data to identify and code categories using the NVivo software package, find common themes in student remarks, and review/compare emerging themes across the group of participants.

After reviewing the data, the four themes identified were (a) student actions, (b) general content knowledge, (c) ecological and environmental knowledge, and (d) perceived proenvironment attitude. Farmer, Knapp, and Benton (2007) present the findings in a narrative format that was challenging to concisely summarize. Table 3.2 highlights some of the most relevant and interesting findings:

Table 3.2: Summary of Participant Remarks

Category	Nature of Remark	Percentage of Students who Remarked
Ecological/Environmental Knowledge	Details representing ecological/environmental knowledge	93% (14/15)
Ecological/Environmental Knowledge	Information about the Wooly Adelgid (an invasive insect species)	80% (12/15)
Student Actions	Used action words to describe what they did on the field trip	100% (15/15)
General Knowledge	Pollution monitoring activity	60% (9/15)
Perceived Proenvironmental Attitude	Conservation and stewardship concepts	40% (6/15)

Of note is the self-selection of study participants. Only 15 of 30 of the

participants self-selected into the study, and only 30 of 51 fourth grade students originally went on the field trip. These figures suggest the sample may have been quite biased. The conclusion the authors drew (mainly, field trip experiences enhance students' long-term environmental knowledge and values) was too broad a claim to make that may or may not apply to other, different types of outdoor educational field trips. Another limitation of the study was its small sample size (n = 15). Small samples, however, are common and accepted in phenomenological research. The methodology section provided a thorough, well-referenced explanation of (and argument in favor of) phenomenological analysis. Whether or not the findings of so small a treatment population, with no pretense of experimental design, are found noteworthy necessarily hinges on one's acceptance of the authors' theoretical positioning and the knowledge claims it provides. Additionally, the study did not utilize member checking to verify the validity of the qualitative findings.

Haluza-Delay (2001) accompanied a group of 14-16 year old male teenagers (*n* = 8) on a 12-day outdoor education field trip through Banff National Park in Alberta, Canada. Her qualitative research incorporated observations and field notes in the first portion of the study (during the trip), followed by two semi-structured interviews conducted fourteen days and six months after the wilderness experience. All of the subjects were from a small, suburban community near Edmonds, Alberta. The outdoor education trip was planned and run by a local outdoor education and recreation center in Alberta and

participation was voluntary. The trip consisted of activities such as backpacking, rock climbing, caving, and canoeing.

The author analyzed her field notes on an ongoing basis in order to form interview questions. The interviews were taped, transcribed, and analyzed using constant comparison and analytic induction to group responses into categories of related ideas, observations, and concepts.

One of the most interesting aspects of this study was the researcher's methodological framework. In focusing on participants' construction of nature and their interpretations of the wilderness experience, Haluza-Delay conscientiously broke from most EE research's behaviorist, deterministic slant toward discovering how a treatment changed an individual. It was an important effort to conduct research informed by constructivist learning theory. She also limited the findings' direct relevance to this particular wilderness trip and these particular participants.

The author found that the trip was a powerful and enjoyable experience for all of the teens, though for a variety of reasons. She also found that most participants expressed concern for the environment, but that their concern did not necessarily translate into positive environmental action at home. Participants' conceptualizations of nature and feelings toward nature following the trip are summarized in Tables 3.3 and 3.4:

Table 3.3: Participant Conceptualizations of Nature

The Qualities of Nature: Nature is…
Undisturbed
Without people

Natural (with trees)
Not human-made
Out there

Table 3.4: Participant Feelings Toward Nature

The Feeling of Nature: Nature is…
Different from civilization
Relaxing or not busy
Free
Unfamiliar

Overall, the researcher found that participants' construction of nature as "other" – defined in comparison or opposition to civilization – influenced their willingness to act for the environment in their home communities. Combined with information about participants' prior experience gleaned through the interview process, Haluza-Delay found that the participants' inclination to conflate nature with wilderness was reinforced or enhanced by the outdoor education trip. She proposed that, in order to reach environmental education's common goal of inspiring positive environmental action, different constructions are probably needed. However, the study did not utilize member checking to verify the validity of the qualitative findings.

In her discussion of the findings, Haluza-Delay posited that programs that take participants away from their home communities to pristine natural settings may be counterproductive to the goals of environmental education. Alternatively, she recommended that: (1) programs more explicitly make the connection between humans, nature, and the local environment; (2) programs focus on knowledge transfer (both cognitive and affective) to home environments; and (3) programs be designed to bring attention to, help students understand and enjoy,

the environment where they live and make clear specific actions that can be undertaken to protect it. Though the sample size (*n* = 8) was very small, and the limitations clearly stated, the findings raised legitimate concern about the focus of environmental education research. The findings gave weight to the critique presented by Haluza-Delay's methodology, suggesting that further research focusing on participants' interpretation of experience and construction of knowledge should be pursued.

In a qualitative, phenomenological study, Knapp and Poff (2001) collected interview-based data from 4th-grade students' (*n* = 24) experience on a field trip in southern Indiana in order to determine its impacts on environmental knowledge, attitudes, and behaviors. Participants were randomly selected from three separate classes in a rural town and asked to participate in an environmental interpretive field trip at Charles Deam Wilderness in the Hoosier National Forest. The trip included ranger-led discussions, exploratory hiking, facilitated explorations, and nature games. The authors described the experience as an interpretive environmental trip. Environmental interpretation was broadly defined as promoting an environmental ethic through a relatively informal educational medium in sites such as parks, museums, and aquariums.

The authors utilized a discursive approach to emergent design to generate a grounded theory based on the approach. In practice, this methodology meant that the data gathered during research guided the design of the study as it was conducted. The study began with an assessment of students' knowledge and attitudes about the site one week before the trip. Post interviews were conducted

one week after the trip and post-post interviews were conducted four months later. The interviews were taped and then transcribed in a log or field journal typical of ethnographic research.

The researchers then coded the responses by categorizing their theoretical, methodological, and observational notes. The first round of coding used to analyze the data used structured and inductive methods with an immersion into the data to break down, compare, and conceptualize statements. This process generated 341 conceptual statements and 27 categories of initial comparisons. In order to describe the conceptual similarities between topics, the next level of coding involved comparisons between the categories using a card sort strategy. This process yielded seven primary categories: (1) memory – affective; (2) game memory; (3) wilderness content; (4) physical surroundings; (5) changes in behavior intent; (6) educational content; and (7) environmental issues. As is typical in phenomenological analysis, the authors completed a final level of coding that identified a central phenomenon or core theme around which all of the primary categories could be integrated.

Overall, the researchers found that student action formed the basis for recollection of the interpretive program and that those actions essentially influenced knowledge and attitude. This conclusion is based on the finding that the highest percentages of student recollections were found in the game memory category. Furthermore, the percentages of students recollecting hidden content from the games (33% short-term, 42% long-term) dwarfed knowledge retention from other, more passive activities. For example, in the educational content

category, only 17% (*n* = 4) of students (the most for any short-term subcategory within educational content) accurately recalled information about birds. Four months later, the highest figure was 33% for students accurately recalling information about predator/prey relationships (content relayed through a game); otherwise, numbers had fallen to the range of 0-8% recollection for every other educational content subcategory. In the long-term, only 1/3 of students remembered the directive leave no trace (the highest of any subcategory in wilderness content). Roughly half of the students (46%, *n* = 11) could accurately identify environmental issues in the short-term following the trip; four months later, the figure had fallen to 17%. Changes in the behavior intent category went from 46 to 29% positive and 50 to 42% neutral/negative for the short- and long-term, respectively.

In their concluding remarks, Knapp and Poff hypothesized that behavior intent – the questions which specifically asked about stewardship/conservation actions for the Deam Wilderness site – was generally low because students had gained very little knowledge about the site during the interpretive trip. However, 96% of the students had a positive affect for the trip/site four months later. These findings call into question the relationship between environmental attitudes and actions, a link supported by other research reviewed in this paper (see, for example, Kuhlemeier, Berg, and Lagerweij (1999)). Yet, a potential point of critique to raise with the authors' measurement of behavioral intent is a consideration of whether all of the actions were accessible to all of the participants. Because the participants were 4th grade students, it is not difficult to

imagine that some the students judged themselves physically (e.g., transportation: can they autonomously make the decision to ride public transportation?) or otherwise incapable (e.g., action competence: do they believe they have the knowledge, skills, and resources to challenge deforestation?) of being able to choose the actions described by the interviewers. Due to this uncertainty, the validity of the behavioral intent finding is questionable and, therefore, clouds what this report really says about the relationship between environmental knowledge, attitudes, and actions. Furthermore, the study did not utilize member checking to verify the validity of the qualitative findings. On the other hand, the results do clearly show that, for this small sample, recollection of active games and explorations was much higher than for passive portions of the interpretive field trip. Further research on what constitutes active versus passive learning is merited in order to design EE experiences with the greatest possible knowledge retention.

Mogensen and Nielsen (2001) conducted a quantitative study of 9th and 12th grade Danish students' (*n* = 845) ability, motivation, and desire to actively solve environmental problems. They developed a survey questionnaire containing 29 open- and close-ended questions based on two central questions:

(1) What is the extent of 9th and 12th grade students' belief in their own action possibilities (BOAP)? How does teaching influence these beliefs?

(2) How aware of current environmental problems are students in grades 9 and 12?

The questionnaire was distributed by mail to fifty-two lower and upper secondary schools and a total of 845 students responded.

The first focus question, regarding students' BOAP, was presented as a Likert-type questionnaire and subdivided into three categories: (a) awareness of one's participation in solving environmental problems, (b) belief in one's ability to solve environmental problems, and (c) desire to act for the environment. Internal reliability was checked using Cronbach's alpha (.69). The second portion of the initial focus question, regarding the effects of teaching on student beliefs, comprised three items on the questionnaire and had an internal reliability factor (Cronbach's alpha) of .70.

The second focus question, regarding students' awareness of environmental issues, was presented both as a series of yes/no questions on specific environmental topics (e.g., global warming, organic agriculture, consumerism, and the health of aquatic environments) and more open-ended questions that were evaluated for students' ability to make, substantiate, and defend a position on environmental issues. Thus, this section of the questionnaire was intended to measure students' environmental knowledge and a skill set identified as important to EE including decision-making and critical thinking skills.

Environmental education is not compulsory in Danish public schools. Rather, like most state standards throughout the U.S., environmental topics are supposed to be integrated throughout subjects. In order to determine how many students were participating in environmental education at school, the final

questionnaire item asked respondents to report whether or not they worked on environmental issues in school. Fifty-two percent replied that they had. The findings of the initial portion of the survey are presented in Table 3.5:

Table 3.5: Belief in Own Action Possibilities (BOAP)

Low or None	15.9%
Moderate	34.6%
Relatively High	33.7%
High	15.9%

The level of BOAP was higher in girls than in boys ($p < .001$) and was also higher among upper secondary versus lower secondary students ($p < .03$). Over two-fifths of the students (41.6%) identified teaching as a central aspect in developing their BOAP, from which the authors claimed a strong correlation between BOAP and the influence of teaching ($r = .42$, $p < .001$). The dependability of this finding was corroborated by Zelezny (1999). Also of note was the finding that 70% of students favored an action perspective in EE; students who stated that they had previously acted on the basis of EE had higher BOAP scores ($p < .01$) and believed more strongly in the influence of teaching on BOAP ($p < .01$).

The second focus question, presented in a series of close- and open-ended questions on awareness of environmental issues, yielded a handful of relevant results. In the critical thinking portion, in which students were asked to distinguish between myth and fact, out of a maximum score of 5 the median was 2, the mean 2.2, and the standard deviation 1.5. However, there was no distinction made between students who had participated in EE programs and those who had not, so that the connection between critical thinking skills and participation in EE programs was unclear. However, the authors correlated

BOAP with scores on the open-ended, critical thinking skills questions (r = .11, p < .001) as well as BOAP with the number of correct close-ended questions in this section (r = .19, p < .001).

The meaningfulness of the results of this study are hampered by the lack of a clear treatment or control group. The authors attempted to determine which students were participating in EE programs on the basis of one questionnaire item that was indirectly worded. Additionally, as this paper and many others have shown, what constitutes EE is an incredibly diverse range of programs and curricula. Therefore, even if exposure to some school-based EE was considered a treatment there is no way of determining what types of programs had what effects on student responses to the surveys. The authors' conclusion that EE has a positive impact on students' beliefs in their own action possibilities raised more questions than it answerd and highlighted the need for future research on specific programs and their outcomes.

Palmberg and Kuru (2000) researched the role of outdoor education in the development of students' self-confidence and agency for 11- and 12-year-olds (n = 36) in the towns of Rovaniemi and Vaasa, Finland. The qualitative, case study-based research incorporated surveys, interviews, drawings, photographs and participant observations to answer the following questions: (1) Do experiences in nature develop students' self-confidence and action skills? (2) What kind of relationships with the natural environment do students have? (3) What does protection of nature mean to students? (4) What kind of responsible action skills do students have? The participants (24 boys, 12 girls) were selected on the basis

of responses to survey questionnaires with the goal of a sample with varied histories of outdoor education. The authors determined that thirty of the participants had the most experience of all of the respondents (overall number of respondents not provided), including attending schools with continuous/consistent outdoor education programs, while the remaining six students selected were chosen as having the least outdoor education experience.

All of the research data were collected during already-occurring, school-based outdoor education field trips that included activities such as hiking, camping, skiing, canoeing, and farming. Interviews incorporated a wide variety of questions on topics such as students' conceptions of and feelings toward nature, what sorts of local or global environmental problems students recognized, what students thought they could do to protect nature, and descriptions of pleasant or unpleasant experiences in nature. Participants were able to answer verbally, draw pictures, and could select from an assortment of photographs when deciding what the most or least attractive environments were. The authors also observed, and sometimes filmed, the participants' actions during outdoor education field trips. Observations included students hiking, setting up and breaking down camp, cooking, building a fire, and playing adventure games. During these observations, the authors focused on students' ability to orient and navigate varied terrain, care for their equipment, cooperate with each other, how students related to the natural environment, as well as their ways of displaying initiative, creativity, and leadership.

The study yielded results in four separate categories, in relation to the four central questions guiding the research (see above). In the category Pupils' Self-Confidence and Action Skills, the authors noted a marked difference between the self-confidence, feelings of safety, independence, and initiative (all amply demonstrated) of those students with more outdoor education (n = 30) experience versus those with less. The less experienced sample (n = 6) were less independent, less able to work cooperatively as a group, and expressed anxiety when attempting new or unfamiliar tasks.

The category Pupils' Relationships to the Natural Environment found that students' conceptions of nature varied widely according to the type and frequency of use of natural environments. Nature was important to most of the students for different reasons. While the authors labeled the overall majority of student responses as egocentric (focus on personal health and safety in nature, and that the environment is something to be used), they noticed that the experienced subgroup of students had more comprehensive definitions of nature and had a stronger, clearer empathetic relationship to nature.

The category Pupils' Knowledge of and Values in the Protection of Nature revealed a general, overall concern for environmental welfare and protection but an unclear or fragmented understanding of specific environmental problems. Roughly half of the students expressed anxiety concerning nature, and pollution was the most commonly cited cause for concern. Several of the pupils, mostly from the inexperienced subgroup, could not give any examples of environmental problems. The most experienced subgroup, alternatively, more strongly

expressed feelings of empathy toward animals, the earth, and other humans and their level of moral development regarding humans' relationship to nature was judged to be higher.

The final category, Pupils' Environmentally Responsible Actions and Action Skills, found that many of the students had trouble thinking of actions to help nature, while others did not want to help. Though most of the students suggested stopping littering or picking up litter as concrete actions to help the environment, many of them also admitted to occasionally littering. The authors also observed two students from the more experienced subgroup harming trees. The authors concluded the category by suggesting that conflict between environmental values and actions may be explained by conscious versus unconscious action and the difference between fragmented and applied knowledge in solving environmental problems.

The authors' conclusions were of a modest scope befitting the relatively small sample size (n = 36). While noticing clear differences between the more and less experienced subgroups of students regarding self-confidence, action skills, and general environmental knowledge and empathy, the distinction became less clear when assessing students' environmentally responsible actions and skills. They suggested further research to determine the connection between different types of outdoor education and environmentally responsible behavior. In the meantime, the authors maintained that their findings were dependable and consistent with similar studies cited throughout the paper and helped to provide evidence supporting the relationship between outdoor environmental education

and the development of environmental knowledge and empathy. However, the 5:1 ratio of experienced to inexperienced students interviewed and observed in the study made for an unequal basis for comparison, a point of critique the authors did not address which may have impacted the findings used to support this claim. Additionally, the study did not utilize member checking to verify the validity of the qualitative findings.

Dettman-Easler and Pease (1999) conducted a survey-based quantitative study of the impact six residential environmental education programs had on participants' (*n* = 697) attitudes toward wildlife. The programs took place across the states of Minnesota, Wisconsin, and Iowa and were all different in length, structure, and curricula. However, the sample population all participated in at least one wildlife-oriented activity at a residential center. Eleven classes, comprised of 697 5th and 6th-grade students, were given pretest questionnaires three weeks before attending the centers, a post-test questionnaire within one week of their return, and a delayed post-test questionnaire 2-3 months after the experience. The results of these surveys were paired against a control group comprised of 5th and 6th-grade students (*n* = 666) from the same schools who participated in an in-class wildlife EE program. The control group completed a pre- and post-test questionnaire, but did not complete a delayed post-test questionnaire.

The survey instrument was designed to determine students' attitudes toward wildlife. It included 27 items on attitudes toward specific animals, 7 items on human needs versus those of endangered species, 4 items on pesticides and

wildlife, and 8 items on ethics of human-animal relationships. Most items were 5-point Likert-type questions with response choices ranging from strongly disagree to strongly agree, including an unsure middle-response category. Three knowledge items were also included so researchers could compare knowledge scores and attitudes. The survey underwent two rounds of field testing and revision and yielded a Cronbach's alpha of .881 before being employed in this study.

The authors used the Systat software package to analyze survey data. The data were analyzed with principal components analysis, Wilcoxon signed-rank test, and Pearson's correlation analysis. A statistical significance level of $p < .05$ was used for all tests. The authors used principal components analysis to determine which survey responses could be cocorrelated and then assigned a single score to those factors. The scores were analyzed with Wilcoxon signed-rank test for differences in pre-, post-, and delayed post-test scores for eleven total factors. The pre-test scores for the experimental and control groups differed on only 1 of 11 factors, demonstrating that their attitudes were not significantly different. Pre- and post-test differences for the experimental group were significant ($p < .05$) on 10 of 11 factors, while pre- and post-test differences for the control group were significant on 5 of 11 factors. For the delayed post-test survey, the experimental group showed significant change between the post-test and delayed post-test on 2 of 11 factors, and retained significant change from the pre-test survey on 8 of 11 factors.

In their discussion of the findings, the authors noted the large number of uncontrolled variables in the study. Some of these variables included staff training and expertise, the length of participants in the experimental group's residential stay, differences in content and structure of experimental group programs, and students' prior EE experience (or simply exposure to nature or wildlife) in both the control and experimental groups. Regardless, the survey data showed that residential EE programs were more effective in fostering significant, positive changes in participants' attitudes toward wildlife than in-class EE programs. The quasi-experimental design, including a delayed post-test survey for the experimental group, bolstered the authors' assertion that residential EE programs promoted lasting changes in student perspectives that can be quantified.

Gunderson (2001) conducted a mixed method study of the K-8 Wilderness and Land Ethic curriculum developed by the U.S. Forest Service and its impacts on student (n = 670) knowledge, attitudes, and beliefs about wilderness. The sample consisted of 174 fourth grade students from 8 public elementary schools and 496 seventh grade students from 6 public middle schools in Colorado, Minnesota, and Montana. The states were chosen because they had a long history of implementing the Wilderness curriculum and had schools with close proximity to wilderness. The schools were chosen to represent a broad range of community sizes from rural to urban. A pre and post-test was administered to students from treatment groups (who were taught the introductory lesson from the curriculum) and a control group (who did not receive the treatment). Based

on previous research, the author chose seven variables to analyze as indicators of students' environmental knowledge, attitudes, and beliefs. Additionally, the author developed a survey on the usefulness and effectiveness of the curriculum based on telephone interviews with teachers who had worked with it in the past. Based on their thoughts, ideas, and concerns, the author developed and administered a mail-back survey (return rate approximately 52%) of a sample of 224 teachers.

Survey and pre/post-test results were analyzed using descriptive and inferential statistical methods including frequency distributions, percentile ranking, means, standard deviations, t-tests, and chi-squares. Analysis of differences between pre and post-test scores determined the significance ($p < .05$) of higher post-test scores and whether or not there was an increase in students' knowledge, beliefs, and attitudes toward wilderness based on criteria established in the Model of Responsible Environmental Behavior. Mean scores from the pre and post-tests were used to establish gain scores within classrooms, and gain scores between pre- and post-tests were analyzed using analysis of variance (ANOVA).

Analysis of the data showed more significant differences from pre- to post-test scores for the treatment group than the control group. Mean treatment scores increased significantly ($p < .05$) on all seven variables by an average of nearly 32 percent, with no significant ($p > .05$) difference in outcomes for the control group. The author determined that the treatment was more effective for seventh grade students than fourth (average score increase of 36% versus 28%,

respectively), and discerned no difference in outcomes between communities of different populations or male and female students. The two variables with the most significant pre/post-test increases were “Knowledge about Wilderness” (39% increase) and “Environmental Sensitivity” (44% increase). The author concluded the study by stating that school-based wilderness education curricula can be effective in educating students on appropriate wilderness behavior.

The large sample size (*n* = 670) and quasi-experimental (pre/post test, treatment/control group) design of the study provided a valuable contribution to the literature on the efficacy of this particular school-based EE curriculum designed by U.S. Forest Service. However, it was curious that the study was conducted after only the initial, introductory lesson of an entire multi-week curriculum. Additionally, the study did not utilize member checking to verify the validity of the qualitative findings. A similar study conducted after the entire curriculum had been implemented seems like a logical next step. A longitudinal study that featured interviews, surveys, or observations of students’ actual wilderness behavior following the treatment would further substantiate the efficacy of the curriculum, which only measured behavioral intent as stated in a classroom setting.

Mayer-Smith, Bartosh, and Peterat (2007) collected qualitative data on the effects an intergenerational food growing program – the Landed Learning Project – had on children’s environmental consciousness. The participants (*n* = 84) were 5^{th}-7^{th} grade students in Vancouver, British Columbia. Small groups of children (3-5) were partnered with volunteer retired farmers and experienced gardeners to

form Farm Friend Teams. Participants visited an urban community garden space twelve times over the course of one school year. Participation in the program was mandatory. Qualitative data was derived from five years (and five separate groups of participants) of program experience. During visits, students engaged in hands-on work caring for, planting, and cultivating vegetables, herbs, and flowers. Classroom teachers integrated themes of food, farming, ecology, and sustainability across subjects and throughout the school year in order to provide comprehensive, environment-based education.

Data was gathered throughout the school year. Researchers documented participant experiences through field notes, digital video, and still photography. Additionally, researchers interviewed the participants' classroom teachers at the beginning and end of the project. Interviews focused on how farm experiences were being integrated with classroom lessons and the provincially mandated curricula, as well as the value and challenges of community-based learning in fostering environmental consciousness among children. Elder farm friends were interviewed to gain a sense of their understandings of their role as environmental mentors for the students. Students were interviewed three times during the project to trace the development of their connection to the environment, as well as their understanding of agriculture and their perceptions of the value of their learning from the elder farm/garden mentors.

After transcribing interviews, the authors analyzed participant responses for indicators addressing the question of whether an intergenerational food growing experience on an urban farm could influence children's environmental

consciousness. The indicators selected re-occurred each year during interviews with participants, but the process of selecting indicators was not quantified or made transparent by the authors.

Over the course of the study, the authors found that students shifted from a view of nature as object or place to a view characterized by the interconnectedness of humans and nature. This perspective, termed eco-centric, was characterized by the following elements of participant responses: (1) increased understanding of the ecology and interconnectedness of nature; (2) growing understanding of the impact humans have on their environment; (3) an emerging sense of responsibility or moral obligation to care for the environment; and (4) appeared to develop a personal (affective) relationship with their environment.

The authors of the study, whose findings they described as preliminary yet promising, were clear about the limitations of the data. The outcomes reported, that the program positively impacted participants' development of their environmental consciousness, could not be generalized to all of the students who participated. Specifically, there were a few students each year who reported not enjoying or liking the food growing program. Researchers also found that the concept of environment was abstract and difficult for 5^{th}-7^{th} grade students to understand, and that it was challenging for the participants to articulate their changing perspectives and attitudes toward the environment.

Finally, long-term impacts of the Landed Learning Project on participants' interests, actions, or career choices were unknown and suggested as topics for

future research. The value of this study to future research, however, is limited by the lack of demographic data for participants and unclear data analysis procedures. It was also difficult to know how big of an impact the classroom-based components of the program had on participant attitudes and perceptions. Although the outdoor program had a high degree of connection with classroom projects and curricula, interview data about the classroom-based components of the Landed Learning Project were not collected. Additionally, the study did not utilize member checking to verify the validity of the qualitative findings. These areas need further elaboration in order to clarify the findings' relationship to the research question.

In a mixed method study of fifth and sixth grade students (n = 66) at a rural, public elementary school in Molokai, Hawaii, Volk and Cheak (2003) evaluated the effects an environmental education program had on student achievement, critical thinking, and environmental literacy. The population of the study was comprised of the entire fifth and sixth grade student body (n = 101). Roughly half (n = 50) of the students were taught using a more traditional, textbook-based, non-integrated curricula. The remaining students (n = 51) learned in classrooms based on the program Investigating and Evaluating Environmental Issues and Actions (IEEIA) which had been in place for five years at the time of the study. The IEEIA program presented subject matter in an interdisciplinary fashion and focused on inquiry skills such as analysis and critical thinking. Additionally, the IEEIA classes were taught by a team of two teachers and concluded each year with a school-wide symposium where students

presented their research findings gathered throughout the school year. The sample population, students who volunteered to participate in the study, was comprised of 38 IEEIA students and 28 students from the regular program who serve as the comparison group. No other demographic data for the population or samples was provided.

The five-member research team collected quantitative and qualitative data over a six-day period while visiting the school. They administered well-established quantitative tests of critical thinking skills and environmental literacy in order to gauge program outcomes. The Critical Thinking Test of Environmental Education (CTTEE) is a multiple choice format test that focuses on skills seen as central to environmental education (for example, making inferences and identifying bias). The results of both groups' tests (IEEIA = 38 versus Comparison = 28) were analyzed using an Analysis of Covariance (ANCOVA) and *t* test comparisons of mean scores. Environmental literacy was measured using the Middle School Environmental Literacy Instrument (MSELI), a test that includes eight subsections including Issue Analysis, Ecological Foundations, and Self-Reported Action. MSELI data were analyzed using *t* test comparisons of the mean scores of both groups.

Qualitative data were collected through 34 interviews of subjects including: 10 IEEIA students (past and present) representing a range of ability levels, 12 parents of (current and former) IEEIA students, 7 community members (local government officials, a journalist, etc.), and 5 school personnel (one administrator, two IEEIA teachers and two teachers from the more traditional

fifth/sixth grade classrooms). The sample was described by the authors as purposive and methodologically opposed to random sampling, but a rationale or framework guiding sample selection was not provided. The interviews consisted of a series of open-ended questions relating to student achievement, environmental attitudes and behaviors, and what (if any) impact the IEEIA program had on the broader community of Molokai. Researchers transcribed the interviews and identified conceptual threads that they sought to triangulate through similar observations in each of the four interview groups.

Because the quantitative sample groups contained unequal distributions of students by grade level, the authors conducted an ANCOVA in order to remove the effects of one variable (grade level distribution) to help clarify the relationship between the categorical independent variable (IEEIA vs. non-IEEIA students) and the dependent variable (CTTEE score). Grade level differences did have a significant effect on mean CTTEE scores ($F = 7.371$, $p = .001$). When this variable was accounted for, the authors conducted a *t* test to compare mean scores. The average score for fifth and sixth graders 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 indicated that the IEEIA students significantly ($p < .05$) outscored the non-IEEIA students on critical thinking skills as measured by the CTTEE. The results of *t* test comparisons on the MSELI test of environmental literacy showed IEEIA students outscored non-IEEIA students on five of the eight subsections of the test, though the scoring differences were significant ($p < .05$) on only three of the subtests: Knowledge of Issues (2.84 vs. 1.24); Ecological

Foundations (10.55 vs. 7.86); and Self-Reported Environmental Action (32.25 vs. 25.97). The qualitative interview data included significant threads on improved reading and writing, improved oral skills, effective use of technology, improved personal characteristics (such as self-esteem, autonomy, and maturity), and widely perceived benefits of IEEIA students on the broader community of Molokai, the state of Hawaii, and the earth itself.

The authors' discussion of the research findings included two broad thrusts. The first emphasized the positive impact the inquiry-based IEEIA program had on student achievement as defined by the acquisition of critical thinking and literacy skills. The authors broadly defined literacy to encompass environmental literacy, technological literacy, as well as more traditional texts, written and oral expression. These conclusions are substantiated by the quantitative and qualitative data. However, the sample size (n = 66) was small and no demographic data for program participants (beyond grade level) was provided.

Additionally, the methodology for interviewee selection for the qualitative portion of the study was not clearly described. Furthermore, the study did not utilize member checking to verify the validity of the qualitative findings. The second portion of the discussion focused on the positive connection between the IEEIA program and native Hawaiian cultural identity. The authors argued that the IEEIA program meshed with elements of native Hawaiian culture (for example, valuing group over individual achievement) and, accordingly, the present study affirms that cultural compatibility of educational curricula (1) increases student

achievement and (2) increases community involvement in schools. While these final points are tantalizing and well-intentioned, the claims are simply not addressed in the quantitative data and are only hinted at in the qualitative data. The authors' suggestion to direct future research of the IEEIA program to other school and community contexts is a worthwhile one, but more information on the current study's sample is needed in order to ensure a diverse research base that would further substantiate the authors' claims.

The eleven studies reviewed in the second section examined a wide variety of environmental education programs, implemented in and outside of the classroom, and their effects on participants' environmental beliefs, attitudes, and actions. The next and final section contains reviews of nine studies on the relationship between diverse environmental education programs and participant academic achievement.

Academic Performance

Studies in this section consistently found evidence of the systematic relationship between contact with nature (structured through a variety of EE programs and approaches) and improved student learning and academic performance. Emekauwa (2004a) studied the impact district-wide implementation of a place-based learning initiative had on academic performance. Emekauwa (2004b) also researched the effects a state-wide place-based learning initiative had on the performance of rural students throughout Alaska. Lieberman and Hoody (1998; 2000; 2005) designed several studies to identify, describe, and analyze the effectiveness of integrated environment-based educational programs

in the state of California and beyond. The National Environmental Education and Training Foundation (NEETF, 2000) studied the effects school-wide adoption of integrated, environment-based education had on academic achievement and disciplinary incidents. Bartosh, Tudor, Ferguson and Taylor (2006) researched the impact of integrated environmental education on student achievement on standardized tests. Lewicki (2000) reported on the impact a year of dedicated place-based education had on student performance on standardized tests. Basile (2000) documented children's participation in outdoor classroom curricula and its impact on knowledge transfer.

Emekauwa (2004a) conducted a quantitative study of the impact implementation of a place-based learning initiative had on academic performance. In 1999-2000, the East Feliciana parish in southeastern Louisiana began Project Connect, a district wide place-based math and science program, in an attempt to reform their poor academic performance. The district includes 5 elementary/middle schools and over 2000 K-8 students, 80% of whom are African American, and 85% of whom receive free or reduced lunch. Fifty-two different teachers participated in one or more of three consecutive summer trainings on place-based learning. This study investigated 4th grade English Language Arts, Math, Science, Social Studies scores on Louisiana Educational Assessment Program for the 21st Century (LEAP 21) from 1998-2002, comparing the district to the state for percentage of students at "unsatisfactory" level.

Project Connect initially began as an effort to improve science instruction and student performance by focusing the curriculum on local ecologies, including

student-led construction of nature trails and butterfly gardens. It was subsequently expanded to include local history, geography, and culture and moved into other content areas including mathematics, social studies, and language arts. From 1999 to 2002, approximately 1800 elementary and middle school students participated in Project Connect classrooms and programs in the East Feliciana school district. In order to foster the implementation of place-based education curricula in the district, a teacher training program was developed and served 52 different teachers. Ten of the teachers received 132 hours of training, and 42 of the teachers received up to 72 hours of training. The impact of the training portion of the treatment cannot be underestimated in a school district in which less than half of the teachers were certified.

Quantitative data revealed a shrinking performance gap between the district and state for all subject areas in the years following Project Connect's implementation. In 1998-99, the baseline year for LEAP 21, 27.3% of the district's 4th grade students performed at the unsatisfactory level in English Language Arts. When the district introduced place-based learning in 1999, the percentage had increased to 32.6%. In the year after place-based learning was introduced, the number of students scoring at the unsatisfactory level in English Language Arts decreased by seven percentage points from year 1999-2000 to 25.4%. By 2001-2002, the percentage had decreased to 18.4, a full 13.2 points from 1999-2000. Over the same period, the percentage of students scoring unsatisfactory in the state decreased by only 6.5 points (from 20.7% to 14.2%).

The gap between the district and the state narrowed from 12.9 percentage points to 4.2.

Similar gains were seen in mathematics, science and social studies. In mathematics, there was a 14.1-point decline for East Feliciana students who performed at the unsatisfactory level, from 39% in 1999-2000 to 24.9% in 2001-2002 (compared to a 3.6 point decline in the state as a whole). The gap between the district and the state narrowed from 9.3 to 4.9 points. In science, East Feliciana's 4th graders posted an 8.1-point decrease in the number of students scoring unsatisfactory between 1999-2000 and 2001-2002 while in the state overall, there was a 3.7-point decrease. In 2000-01, East Feliciana's 4th graders tied the overall state performance in science. In social studies, there was an 11.3-point decrease in the number of students scoring unsatisfactory compared to a 3.2-point decrease for the state overall.

Emekauwa's (2004a) study, in its collection and presentation of the data, clearly showed the positive gains the heterogeneous, overwhelmingly low-SES student population of East Feliciana school district made on the LEAP 21 standardized test between the academic years 1999-2002. The study highlighted the importance of teacher training and collaboration to the place-based learning program's successful implementation. The study made no mention of other school or district-wide reforms enacted during this time period. Discussion of the results included brief notes from interviews with teachers and the project coordinator for Project Connect, lending qualitative support to the correlation between the project's implementation and improved student performance.

However, there is no analysis of the data linking the improved student performance directly to Project Connect. Future research to further substantiate the correlation might include a more in-depth explanation of teacher training and more explicit information about the reforms in curriculum, planning, etc. that Project Connect included. Educators, administrators, and others could then determine what (if any) specific pieces of Project Connect they are capable of implementing, or whether the model as a whole can be successfully replicated in schools or districts with similar demographics.

In a quantitative study of rural Alaskan students (*n* = 18,982), Emekauwa (2004b) researched the effects a place-based learning initiative had on student performance. In 1995, the Alaska Federation of Natives, the University of Alaska, and the Alaska Department of Education and Early Development began a ten-year rural school improvement effort, the Alaska Rural Systemic Initiative (AKRSI). AKRSI was a broad-based, state-wide education reform program that sought to develop pedagogical practices and curricula that were culturally compatible with indigenous knowledge systems and relevant to daily life in poverty-stricken rural Alaska. The process of developing educational practices and curricula included organizing the Alaska Native Rural Education Consortium and a series of related forums, conferences, and media in order to engage broad swathes of communities and educators in the reform process.

Phase I AKRSI (1995-2000) was enacted through a major collaboration among tribal elders, the state, higher education, regional and local school districts, teachers, parents, students and national interest groups, including the

Rural School and Community Trust. Phase I AKRSI had five major foci:

(1) Native Ways of Knowing and Teaching: Training pre-service and in-service teachers in rural areas to integrate Native Alaskan cultural standards and related pedagogical practices – including indigenous knowledge and use of the physical environment – into the school setting.

(2) Culturally Aligned Curriculum Adaptations: On a district by district basis, developing culturally aligned curriculum that balanced and integrated Native and non-Native knowledge and skills. Emphasis was placed on ensuring the structure of curricula, teaching contexts, and assessment procedures were culturally appropriate.

(3) Indigenous Science Knowledge Base: With the help of students, compiling a comprehensive resource database documenting the cultural and ecological knowledge of Native Alaskan people in each of the state's five major cultural regions. Culminated in the development of a Regional Cultural Atlas available to teachers at all grade levels covering all subject areas.

(4) Elders and Cultural Camps: Established an elders-in-residence program and associated cultural camps as vehicles for integrating the knowledge and expertise of Alaskan Native elders into the education system.

(5) Village Science Applications: Encompassed activities to foster Native students' interest in science-related careers, including increased exposure to documenting, observing, and doing science in field and laboratory settings.

Twenty rural school districts participated in Phase I AKRSI activities. Together, these districts housed 176 schools serving approximately 18,982 students – nearly 60% of all rural students in the state and 90% of rural Alaska Native students. These school districts served primarily Native students and have historically posted the lowest student achievement scores in the state and nation. Teacher turnover rates range as high as 30% annually in many districts.

In order to document the effects of the AKRSI reforms, Emekauwa (2004b) collected data comparing student performance between the 176 AKRSI schools and the remaining rural non-AKRSI schools (*n* = 28) throughout Alaska. Measures of student achievement for the years 1995-2002 included mathematics standardized test scores (CAT-5, a national norm-referenced test, and the state's High School Qualifying Examination), drop-out rates, and first-time college entrance. In 1995, 17.4% of 8th graders in AKRSI schools scored in the top quartile on the CAT-5, compared to 29.1% of students in non-AKRSI rural schools. By 1998, the gap had narrowed from 11.7 percentage points to 5.8 (24.3% and 30.1% scoring in the upper quartile, respectively). For the mathematics portion of the CAT-5, from 1995 to 1999 AKRSI schools gained 3.9% in the number of students scoring proficient or advanced, compared to a .97% loss for non-AKRSI rural schools and a 1.2-point gain statewide. By 2002, the gap between AKRSI and non-AKRSI rural schools had decreased by 4.85 points and between AKRSI and schools statewide by 2.68 points. AKRSI students also outperformed Alaska Native students as a whole by over five points. Between 2000 and 2002, AKRSI tenth graders scoring proficient or

advanced on the math portion of the state's High School Qualifying examination increased by 8.36 percentage points from 19.95% to 28.31%. Though this gain showed a 5.61-point differential over Alaska Native students as a whole, it was less than the 12.65-point gain made in non-AKRSI rural schools and the 10.7-point gain statewide.

Additionally, student dropout rates for grades 7-12 in AKRSI partner schools declined from a mean of 4.4 in 1995 to 3.6 in 2000, a 0.8 percentage point change, compared to the non-AKRSI rural schools' dropout rate decrease from a mean of 2.7 to 2.4 (a decline of .3 percentage points). Between 1995 and 2001, first-time college enrollments for students from AKRSI districts increased 49% and surpassed (in total) the number of students enrolling from non-AKRSI rural schools.

The conclusions reached in this observational study, that the place-based AKRSI educational reform movement has produced positive effects in all indicators of student success, are somewhat overstated given the data provided. The data clearly showed that 8th grade students at AKRSI schools are improving their CAT-5 mathematics test scores at a faster rate than their non-AKRSI rural school counterparts, as well as outperforming Native Alaskan students as a whole. While 10th grade students at AKRSI schools showed significant gains in the number of students testing well on the state's High School Qualifying Examination, showing a 5.61% differential over Alaskan Natives as a whole, the gains were outpaced by students at non-AKRSI rural schools as well as overall statewide gains. Dropout rates have improved marginally and first-time college

enrollment numbers have increased substantially (49% from 1995-2001). Given the overall positive results of the Alaska Rural Systemic Initiative program, it may be beneficial to focus further research on a smaller scale to see how specific schools, classrooms, or individual students are translating the changes brought about by AKRSI into improved performance and achievement.

Lieberman and Hoody (1998; 2000; 2005) produced a series of what are perhaps the most-cited research studies on environmental education and student achievement over the past decade. Their research is supported by a consortium of education agencies from twelve states, the State Education and Environment Roundtable (SEER), who have identified and loosely defined a model of integrated, environment-based education termed EIC. Using the Environment as an Integrating Context (EIC) for learning is both a description of successful school programs (the focus of SEER's research) and a prescription for environment-based education guidelines (the goal of SEER's advocacy). The conceptual framework for EIC-based learning can be broadly defined as place-based pedagogy (using the local environment and community as primary learning resources) that incorporates a host of educational practices informed by constructivist learning theory – EIC is often interdisciplinary, hands-on, collaborative, inquiry-based, and centered on the learner. Lieberman and Hoody (1998; 2000; 2005) found that students in EIC-based schools showed broad gains in performance including increased standardized test scores and GPAs, reduced disciplinary incidents, and increased engagement and enthusiasm for

learning. Each study will be critically reviewed in order to determine the validity of their research and the conclusions reached based on their findings.

In a sweeping, mixed method study of forty schools from across the United States, Lieberman and Hoody (1998) investigated the impacts schools utilizing environment-based curricula (fitting the EIC model) had on student achievement. Students (*n* = 403), teachers (*n* = 219) and administrators (*n* = 33), from elementary (15), middle (13), and high schools (12) were interviewed and completed three separate surveys concerning the effects of EIC. Fourteen of the case study schools conducted their own comparative analyses of data for both EIC and traditional students, providing the researchers with quantitative data on measures of student performance such as standardized test scores, grade point averages, student attitude measures, disciplinary referrals, and attendance rates.

Schools were chosen based primarily on their level of integration of the environment across curricula, student involvement in projects and problem-solving, extent of team teaching, and program longevity. Whether or not schools met these criteria was determined by 45-90 minute phone interviews with school faculty or administrators by researchers. Researchers also considered demographic data such as setting (rural to urban), population of surrounding community, and income levels when selecting schools. Income levels were estimated using the percentage of students receiving free or reduced-cost lunch: 40% of schools included in the study had 0-25% of students receiving free or reduced lunch; 33% had 26-50%; 17% had 51-75%; and 10% had 76-100%.

Over 200 schools were screened before forty were selected as having met the criteria.

Interviews consisted of questions related to (a) qualitative effects of using the environment as an integrating context, (b) indicators and specific evidence of change, and (c) educators' insights into the causes of observed changes. Additionally, the authors developed three survey instruments in order to clarify interview results and to reduce researcher bias in categorizing participant responses. The Learning Survey focused on student learning of subject matter, interpersonal skills, basic life skills, and overall student achievement. The Domains Survey focused on knowledge, skills, retention, and attitudes toward learning in language arts, math, science, and social studies. The Teachers Survey, which dealt with teacher interest and enthusiasm for EIC-based programs – as well as factors such as available resources and administrative support – would be useful to future research on the implementation of EE, though it falls outside of the scope of this paper's research question. Interviews were recorded, then transcribed and summarized by research staff and professional transcribers. The research team compiled and analyzed survey results using computer spreadsheets.

The reported results of qualitative data for participant interviews and surveys are quite extensive. In the General Education Parameters section of the Learning Survey, a percentage of educators reported student improvement in the following categories: standardized test scores (77%); GPAs (73%); improved behavior (70%); student engagement (98%); ability and willingness to stay on

task (89%), adaptability to various learning styles (94%); and practicing civility toward others (93%). However, a different number of educators responded to each of these survey items, reducing the generalizability of the findings. For example, only 60 of 252 (24%) educators reported on the test scores item while a more substantial 173 of 252 (69%) reported on student engagement.

Further qualitative, interview-based data was gathered on perceived student achievement in core academic disciplines. According to the Language Arts Domain Survey, on average, 89% of educators (44% responding) felt student achievement (knowledge, skills, retention, attitudes, and opportunities) had improved following implementation of EIC-type programs. On the Mathematics Domain Survey, an average of 86% of ninety-one respondents (36%) felt that student achievement had improved. On the Science Domain Survey, an average of 98% of 123 respondents (48%) believed student achievement had improved. Finally, on the Social Studies Domain Survey, an average of 95% of 110 respondents (43%) noted growing student achievement.

Fourteen of the study schools conducted their own analyses of quantitative data, such as standardized test scores and GPAs, comparing EIC and traditional students. Lieberman and Hoody (1998) summarized the findings by highlighting some of the specific cases. For example, 4th grade students at Hollywood Elementary scored an average of 27% higher on the Maryland State Performance Assessment Program (MSPAP) than other schools in the same county and 43% higher than Maryland as a whole (based on 1997 data). Between 1995-1996, 9th grade EIC students at Little Falls High averaged a 2.95

GPA compared to 2.42 for other 9th grade students at Little Falls. Overall, the researchers found that EIC students outperformed their traditional counterparts in all fourteen case studies.

The presentation of quantitative data was purely descriptive and offered no statistical analysis of the significance of the findings or validity connecting the observed outcomes with EIC-based instruction. Furthermore, the methodologies undertaken to conduct each school's self-analysis were not reported. Therefore, the relevance of the quantitative findings presented in this study is extremely limited. The qualitative data, on the other hand, offer more substantive findings of EIC-based programs' positive effect on student achievement. As reported, the results of the surveys were very positive. However, less than 50% of study participants responded to any survey item, and sometimes as few as one third responded. This may have created a biased sample; without a higher response rate, it is unclear whether or not the survey results are generalizable to the sample schools as a whole, much less generalizable to schools not chosen for this study.

Liberman and Hoody (2000) conducted a quantitative study of the educational efficacy of EIC-based instruction (treatment, *n* = 8 schools) versus more traditional approaches (non-treatment, *n* = 8 schools) measured by standardized test scores as well as any behavioral changes (measured by attendance rates) throughout the state of California between 1997 and 1999. With the aid of the study schools and their school districts, the authors collected quantitative data on student scores on three norm-referenced achievement tests:

the Stanford Achievement Test (SAT), California Test of Basic Skills (CTBS), and California Achievement Test (CAT). Attendance rates were compared using annual percentages of actual attendance. In order to select the sample schools, the authors utilized 23 rubrics designed by the State Education and Environment Roundtable (SEER) to assess school programs' relationship to EIC's central pedagogical precepts (described above).

The three central common characteristics of treatment schools or programs were: interdisciplinary curricula; learning that took place outside of the classroom (in nearby nature or community); and inquiry or issue-based instruction. Non-treatment schools were described as teacher or textbook-directed curriculum that emphasized discipline-specific, classroom-based activities. Treatment schools outperformed non-treatment schools in language arts (69 of 91 assessment, 76%), mathematics (17 of 27 assessments, 63%), science (7 of 11 assessments, 64%), social studies (8 of 11 assessments, 73%). Overall, treatment schools outscored non-treatment schools on 101 of 140 academic assessments (72%) and on 17 of 22 (77%) measurements of attendance rates.

In one of two within-school comparisons, the control group at Lincoln High School outperformed EIC students on 7 of 13 assessment measures (54%). The only school to serve as a control group twice in the study, Cummins Elementary School, was outperformed on 35 of 41 assessment measures (85%), raising the question as to why such a poorly-performing school was used twice and how significant an impact its double-inclusion had on the data. Beyond these troubling

cases, the data clearly showed that EIC students outperformed non-EIC students on measurements of academic achievement and annual actual attendance rates.

Although the SEER rubrics ensured that school programs could be accurately considered EIC (treatment) or non-EIC (control) for the purposes of this study, no further information (demographic, etc.) was provided to make the case that the paired schools or programs were valid comparisons beyond stating they were matched using demographic and socio-economic descriptors. For two of the sample comparisons, the programs were within the same school; the likelihood that they are fit for comparison is much higher than the remaining six paired samples that compare programs in two separate schools. Within this subgroup of within-school comparisons, EIC students outperformed non-EIC students on 66% (26 of 39) of measures. Although the researchers mitigated the effect of some confounding variables (e.g., the effects of program initiation by omitting treatment programs with less than two years of implementation), other variables effecting the outcomes of the study of such a large, heterogeneous sample were not taken into consideration (for example, teacher qualification). Furthermore, the authors did not calculate standard deviations for the data because of the sample size. However, a paired *t*-test of mean treatment and control group scores would have provided an indication of whether or not the data was normally distributed.

In a follow-up study in which many of these research design shortcomings were addressed, Lieberman and Hoody (2005) compared the educational efficacy of EIC-based programs among four paired elementary schools in

California over a five year period for over 12,700 sets of student data. Following the 2000 study, the California Department of Education (CDE) created a school classification system called Similar Schools Rank that provided the authors with a more rigorous comparative methodology for creating the pairings of treatment and control schools. The Similar Schools Rank takes into consideration demographic data regarding: pupil mobility; ethnicity; SES; percentage of teachers who are credentialed; percentage of teachers holding emergency credentials; percentage of ELL students; and average class size per grade level. Lieberman and Hoody used the same SEER rubrics to assess schools' adherence to EIC-based learning. The report used data from California's Standardized Testing and Reporting (STAR) assessment system, which included the nationally normed Stanford-9 (SAT-9) and a separate test for ELL students. All of the test data in the report were evaluated for statistical significance ($p < .05$).

The first comparison was made between two small, urban K-5 elementary schools with similarly high-SES student populations, comparable class sizes, and similar percentages of ELL students. Over 3,300 sets of student data were collected for Brookside and Rancho elementary schools during the five-year comparison. Tables presented as summary findings for each case study indicated the number of instances when the control or treatment group scored significantly higher than its counterpart. Entries indicated the number of years, out of the five years of the study, in which a school's students scored significantly ($p > .05$) higher on the standardized tests administered in each subject area.

For reading, in all cases in which there was a significant difference the treatment group scored higher than the control group. For math, treatment group students scored significantly higher in 25% of the cases while control group students scored significantly higher in 20% of the cases. In language, control group students significantly outscored the treatment group in 20% of the cases while the treatment group scored significantly higher only 15% of the time. In spelling, treatment students outscored control students in each case in which there was as significant difference. Overall, the treatment group outscored the control group in 18 of 26 (69%) cases in which there was a significant difference. However, there was a significant difference between scores in only 26 of 80 (33%) cases, a figure the authors omitted.

Although Open Charter and Riverside Drive elementary schools had very different enrollment numbers (365 and 778, respectively), they shared similarities in every other demographic category considered. For example, the percentages of students receiving free or reduced-cost lunch was 28% and 26.1%, respectively, and the average class sizes were 22.8 and 19.5, respectively. The authors summarized over 3,600 sets of student data for Open Charter (treatment) and Riverside Drive (control). In this second case study the comparison was much clearer. Scoring differences were significant ($p > .05$) in over 81% of cases (65 of 80) and the treatment group outperformed the control group in 100% of those cases.

The third case study was a comparison of two urban K-5 elementary schools with very similar demographics in every category considered, save

percentage of ELL students who were 7% of the student body for Maguire (treatment) and 2.5% of the study body for Pleasant Valley (control).

This case study comparison of over 3,400 sets of student data showed the fewest number of cases in which differences in performance between the treatment and control groups were significant (25 of 80, or 31%). However, in math the treatment group significantly outscored the control group in 40% of instances (8 of 20) versus 10% (2 of 20) of instances in which the control group outscored the treatment group. Similarly, in language the treatment group significantly outscored the control group in 30% (6 of 20) of the cases while the control group never significantly outscored the treatment group. Overall, in instances where scoring differences were significant, the treatment group outperformed the control group 84% of the time (21 of 25).

The final comparison between Thomas and Tamalpais Valley elementary schools (over 2,400 sets of student data) yielded results consistent with the other case studies. In all 30 of 80 (38%) instances in which scores were significantly different, the treatment group outperformed the control group. The widest gap was in mathematics, where treatment students at Thomas significantly outperformed Tamalpais Valley students in 9 of 20 (45%) total cases.

Overall, treatment students significantly ($p < .05$) outscored control students in 42% of cases (134 of 320), while control students outscored treatment students in only 4% of cases (12 of 320). However, over 50% (174 of 300) of the cases showed no significant scoring differences between the sample populations. The sample selection procedures utilized in this study were much

more rigorous and lent validity to the findings which affirmed previous research by Lieberman and Hoody (1998; 2000). The sample selection process assured comparisons that helped isolate the dependent variable to curricular structure, design, and implementation and mitigated against previously unknown dependent variables such as class size, SES and other demographic differences between students, and teacher qualifications.

The relationship suggested between EIC-based programs and student achievement (measured by standardized test scores) is supported by the data. In these studies, EIC programs – despite their diversity – are considered a uniform independent variable. In order to disambiguate the results, a fruitful next step would be, given the heterogeneity of programs included under the EIC umbrella that defined treatment groups in this and previous SEER-affiliated studies, research that takes different attributes of an EIC program as variables and analyzes outcomes using a multiple analysis of variance (MANOVA) in order to break down a treatment into multiple variables. As the study stands, it is not possible to determine what aspects of pedagogy or elements of content resulted in greater student achievement.

The NEETF (2000) conducted a quantitative study on the impact integrating environment-based education had on student achievement in a variety of case study schools. The study selected sample schools based on criteria developed by the State Education and Environment group for using the Environment as an Integrating Context for learning (EIC) (see, for example, Lieberman & Hoody 1998). The first case study involved a first grade classroom

(*n* = 19) in Pasadena, Texas. Kruse Elementary School received Title I funding and of its 900 students, mostly Hispanic (no data given), 87% received free or reduced-cost lunches. Comparisons of Iowa Test of Basic Skills scores were made between the control group, who learned in an EIC environment, and the other first grade classes, as well as the performance of the school as a whole and national averages. The scores, expressed as grade equivalencies (1.6 = grade 1 + six months), showed that the control group outperformed other first grade classes at the school in reading (+.5), language (+.4), mathematics (+.2), word analysis (+.3), and computation (+.3) in 1995. A group item analysis between the control group, the entire school, and national norms showed the control group outperforming the school on 8 of 9 subtests and outperforming the national average on 9 of 9 subtests in 1998.

The second case study involved Isaac Dickson Elementary School in Asheville, North Carolina. Many of the urban school's 330 K-5 students lived in housing projects and, according to the school's principals, roughly 50% were from low-income families. In 1998, instruction was realigned to focus on outdoor EE and service learning projects including student-led re-establishment of a nearby nature trail and construction of school gardens. From 1998 to 1999, the number of 3rd-5th grade students testing at or above grade level on a state proficiency exam grew in reading (+9%), math (+7%), and writing (+11%). The school's writing scores exceeded the state average for the first time in history.

Located in Minneapolis' southern suburbs, the School for Environmental Studies (SES) at the Minnesota Zoo opened in 1995 as an optional public high

school for 200 juniors and 200 seniors. The school is organized into four houses, each with 100 students and three faculty members. Each house accommodates 100 students and three instructors and contains a central area for assemblies and large group instruction. This central space, or centrum, is surrounded by 10 cubicle-like offices, called pods, for small- group and independent learning. The school curriculum is thematic and custom-designed (based on district-wide concepts judged appropriate for the particular grade level) by school staff. In a comparison of raw ACT scores for sample years 1998 and 1999, SES scores outperformed both Minnesota and national averages in each area of testing and composite scores two to three points higher both years.

Tompkinsville Elementary School in rural Kentucky began a serious overhaul of curricula in 1995 by creating a outdoor learning spaces and integrating EE across subjects in the classroom. Many of the pre-kindergarten through fifth grade students' (*n* = 630) families qualify for free or reduced-cost lunch (no data given). Concurrent with the development and implementation of environment-based education at Tompkinsville Elementary, standardized test scores rose. Fourth grade scores on the Kentucky Instructional Results Information System (KIRIS) test showed an overall increase in science(+25.85 points), reading (+22.46), and social studies (+39.63). The final case study documented in this report, Hawley Environmental Elementary School in Milwaukee, Wisconsin, underwent a deep period of reform from 1989-1998 that went well beyond developing EIC-style learning programs. For example, the school fully integrated its curriculum with Milwaukee's School-to-Work program

after aligning it with state standards. Because the reforms, many of which were only tangentially related to EIC, were so extensive, the current author decided to omit it from serious consideration.

In their discussion of the results, the NEETF were careful to state that integrated, place-based education programs fitting the EIC model were one factor that improved student performance. Without more comprehensive demographic data on the samples, it is not possible to determine the comparability of the control and comparison groups. Also, due to the heterogeneity of the EE programs developed and implemented at each of the case study schools, the question of what exactly positively impacted student performance remains unclear. What aspects of the programs contributed to increased student performance? Additionally, the simple observations made on the statistics for each case study did not include any data analysis to suggest whether the results were significant or not. Without any attempt to isolate and test for specific variables in each case, and with no attempt to account for unknown variables (such as maturation), the usefulness of this frequently-cited report is extremely limited. A more complete presentation of data and transparency in data collecting and analysis procedures are necessary to further validate the findings.

Bartosh, Tudor, Ferguson and Taylor (2006) compared student scores on the Washington Assessment of Student Learning (WASL) between 77 pairs of schools with integrated environmental education (EE) programs and those with more traditional curricula. The authors utilized a set of Environmental Education

Rubrics (developed jointly by numerous state agencies, businesses, and educational organizations) to assess the level of implementation of EE by schools. The rubrics included six broad categories (school commitment to integrate EE into the curriculum, curriculum development, instruction used in the classroom, student learning, assessment, and community commitment) and were evaluated by independent, third party experts in order to select schools with well-developed EE programs.

EE schools included in this study had at least three years of practicing EE strategies, had 20% of teachers/classrooms and at least 33% of students involved in EE programs. For each EE school a comparison school was identified using U.S. census and other economic, demographic, and geographic criteria. The EE and comparison schools had nearly identical mean school sizes (550 to 547) as well as percentage of students eligible for free/reduced lunch (26.6 to 26.8) and extremely similar racial/ethnic student compositions (less than 1% difference for any demographic category). The data on school achievement on the Washington Assessment of Student Learning (WASL) test for 1996-2002 was obtained from the Washington Office of Superintendent of Public Instruction (OSPI). The WASL is a criterion-referenced test aligned with state standards that measures skills in math, reading, writing, and listening. Researchers analyzed the data using paired *t*-tests as measures of significance, as well as longitudinal analysis in order to identify trends in student achievement on the standardized tests.

The authors found that EE schools consistently outperformed traditional schools on the WASL test. The mean percentages of students who met standards on the WASL were higher in EE schools in every subject. Although the authors' graphic representation of the data was not clearly decipherable, it appeared that the percentages of EE students who met standards on WASL was between 3-5% higher on average. In 73 pairs out of 77 EE schools had higher scores in at least one subject. According to the descriptive statistics and *t*-tests performed there was a significant difference in math, reading, writing, and listening on the WASL tests.

The authors also provided the results of a paired samples test for six pairs of both populations. The *p* values for each pair suggest significant differences ($p < .05$) in the populations' scores. Longitudinal analysis showed that EE schools had higher mean percentages of students who met standards on the WASL for the period 1997-2002. The mean values are consistent across paired differences; given the 95% confidence interval of the difference in mean scores, the values are distinguishable and do not overlap. However, the patterns of change over time are similar for both populations. The data on standard deviation appears to be recorded incorrectly; the decimal point should be moved one digit to the left for each pair. The authors suggested a variety of unknown variables (outside of the research parameters) that may have influenced the test results. Some of these variables included school funding, administrative policies, and diverse teaching and learning practices.

In the final analysis, the authors proposed that the study indicated a pattern rather than correlative relationship between integrated EE programs and student achievement on the WASL test. Given the number of unknown and/or unaccounted for variables that impact student performance on standardized tests, this conclusion is appropriately modest in scope. Further research on what factors affect test scores is needed. However, the data did indicate that on average EE students outperformed comparable (demographically, geographically, etc.) non-EE counterparts on the WASL tests for math, reading, writing, and listening between 1997 and 2002. In depth research on what specific practices in the heterogeneous EE schools brought about increased performance is needed in order to further substantiate the link between EE and student achievement.

In a quantitative study of one class's (n = 14) performance on the Iowa Test of Educational Development, Lewicki (2000) sought to determine the impact one year of learning in a charter school dedicated to place-based education had on students' ability to meet state standards. Demographic data for the subjects is limited to location (Westby, a rural town in Wisconsin) and grade level (9^{th}).

The school's structure and curricula, described by the study's author (who was also the founder and a faculty member of the school) as a pedagogy of place, included 100 days of field studies dedicated to exploring local history, ecology, and culture in settings as diverse as wetlands, historical archives, museums, and a senior citizen community. Students participated in a model of holistic education that approached themes and concepts through an

interdisciplinary lens and often worked with professionals and community members outside of the school setting.

To measure students' ability to meet state standards, the author administered the Iowa Test of Educational Development (ITED) to fourteen first-year students in September and June of the same school year. The ITED is a commercial, national, norm-referenced test that focuses on critical thinking skills such as analysis and evaluation. The pre/post test design did not include a control group to mitigate potential confounding variables such as maturation or exposure to skills or knowledge outside of the school setting. Remarkably, students made gains on every section of the test – including a composite score (all subjects combined) that increased by nearly three grade levels. The overall results are summarized in Table 3.6:

Table 3.6: Impacts of EE Intervention on ITED Performance

N = 14 Freshman	Grade Equivalent Pre-Test	Grade Equivalent Post-Test
Science	10.6	13.6
Social Studies	9.3	12.2
Reading	10.4	12.7
Math	8.5	12.6
Writing	8.5	12.4
Sources of Information	8.2	11
Literary Skills	10.3	12.8
Composite Grade Equivalent	9.8	12.5

The author identifies four aspects of the school's structure and curricula that contributed to the increases in students' scores: (1) size of the learning community; (2) anchors of place; (3) experience; (4) audience and authentic assignments. These four points, though philosophical cornerstones of the school

model, are cited as conclusions without any supporting evidence linking them to student performance on the ITED. As the author states, “I understand my experience was very unique, and unlike most high schools” (Lewicki, 2000, p. 9). This raises the question of whether or not the conditions were realistic and, additionally, whether the same improvements in student test scores could be expected in other settings that do not fully replicate the school’s model (including the strikingly low student-teacher ratio). Though the improvements in test scores were impressive, due to the design of the study (uncontrolled factors such as maturation) and the small sample size (n = 14) it is reasonable to draw only inspiration (and further questions) from the paper and look elsewhere for supporting research.

In a quasi-experimental quantitative study, Basile (2000) examined the effects an outdoor nature investigation program had on knowledge transfer for third grade students (*n* = 46) in an urban elementary school. The study utilized a nonrandomized pretest/post-test design. One third grade teacher taught two groups of students two different seven-week science programs. During the first week of the curriculum, the control group watched a video in which the protagonists were presented with a problem-solving situation. After watching the video segment, the researcher collected data on students’ declarative, procedural, and schematic knowledge relating to the video in written and oral interviews. During week seven, near the end of a traditional biology curriculum focused on habitat, students in the control group watched another video that portrayed a similar problem-solving situation with a related context (birds). Data

collected during written and oral interviews at this stage were considered a test of near transfer of knowledge. A third and final video clip, watched three weeks after the program had ended, presented a problem related to habitat but in a totally different context (space) – the results were considered a test of far transfer of knowledge.

The treatment group was given the same schedule of tests, video problem-solving situations, and interview procedures. However, the content and structure of the seven-week science program differed greatly. The inquiry-based curriculum was based on developing problem solving skills and thinking strategies such as analysis, synthesis, and evaluation. The treatment program was also rooted in the scientific method and included a one-day field trip to a nature center.

The dependent variable, knowledge, was measured using a pretest/post-test performance checklist called the Knowledge Indicator Instrument that included questions on declarative, procedural, and schematic types of knowledge. The Matrix Analogies Test and Science Attitude Survey were used as covariates, and the Science Observation Instrument was used to ensure the fidelity of the treatment. The validity and reliability of the instruments were assessed during an earlier pilot study (data not provided).

To ensure statistical significance ($p < .05$), the author used a multivariate analysis of covariance (MANCOVA) to analyze the data. Effect sizes were also computed ($\Delta > .33$). The results showed that there was not a statistically significant difference ($p = .120$) or an educationally significant difference ($\Delta =$

.19) for the test of near knowledge transfer between the treatment and control groups. However, there was a statistically significant difference (p = .001) and an educationally significant difference (Δ = 2.19) for the test of far knowledge transfer. These results demonstrated that students in the treatment group were better able to transfer knowledge in a far transfer situation.

The author went on to analyze each type of knowledge separately. For declarative knowledge, the author found that the treatment group was better able to transfer knowledge in near transfer situations but not in far transfer situations – results that contradicted the overall findings. MANCOVA results for the near/far tests were p = .003 and .826, respectively, and effect sizes were Δ = .80 and .13. The near transfer situation procedural knowledge results showed a significant effect size (Δ = .85) but a statistical significance (p = .056) slightly outside of the accepted range. The far transfer procedural knowledge test showed both a statistical (p < .001) and educational (Δ = 2.17) level of significance. As in the overall results, data showed only statistical (p = .004) and educational (Δ = 1.98) significance in the far transfer situation for schematic knowledge.

In her discussion of the findings, Basile noted a host of limitations for this study: small sample size (n = 46), intact groups, generalizability, and possible instructor bias. Her recommendations were all sound: increased sample sizes, more diverse sample sizes (though no demographic data was provided for the sample in this study), and different age groups for samples. Basile's broader, direct challenge to future research in EE was to focus on a more authentic

measure of student learning – knowledge transfer – as opposed to test scores or grade point averages. Because the EE program in which the treatment group participated was geared toward developing problem-solving and inquiry skills, there is little wonder that students outscored the control group (whose curriculum focused on rote facts and lower-order thinking skills) on knowledge transfer tests. Further research is necessary to generalize the findings of this study to broader populations and determine if the specific type of EE treatment played a major role in shaping the outcomes.

Summary

In order to determine the effectiveness of contemporary EE programs in promoting environmentally sustainable values and actions in their student participants, chapter three provided a critical review of current research (1998-2008) in the field. The literature review was broken into three sections.

The first section examined children's perceptions, use, and valuation of natural and constructed environments close to home. Using, in some instances, ecological models of analysis that incorporated individual and environmental factors effecting decision-making, studies in this section suggested that use of local environments was directly connected to parental and youth perceptions of safety (Temperio et al., 2004; Tandy, 1999; Veitch et al., 2004). Other studies found that young children and middle school students held positive views of the environment (Evans et al., 2007; Kuhlemeier et al., 1999) and that EE programs that exposed students to nearby nature increased student awareness of the environment (Fisman, 2005; Lindemann-Matthies, 2005; 2006). One study found

a connection between place identification and environmentally responsible behavior (Vaske & Kobrin, 2001) while another suggested childhood experiences in nature were critical to the development of active commitment to the environment as adults (Chawla, 1999).

The second section included studies concerned with determining the effects a wide variety of environmental education programs on participants' environmental beliefs, attitudes, and behaviors. Zelezny (1999) found that EE interventions in classrooms more effectively improved environmentally responsible behavior than interventions outside of classrooms. Studies of outdoor environmental education programs yielded inconsistent results. Knapp and Poff (2001) found little connection between increased environmental knowledge and improved self-reported behavioral intent. Farmer et al. (2007) found that one-day outdoor education experiences can increase long-term environmental knowledge, but documented little connection between environmental knowledge and attitudes. Another study found no significant differences in environmental knowledge, values, or behavior between treatment and control groups (American Institutes for Research, 2005) while Haluza-Delay (2001) reported little change in participants' environmental conservation or stewardship behaviors following a twelve-day outdoor education trip.

In order to develop a more complex analysis of antecedents to environmentally responsible behavior, two studies incorporated the concept of action competence into their research. Mogensen and Nielsen (2001) concluded that EE has a positive impact on students' beliefs in their own action possibilities,

while Palmberg and Kuru (2000) determined that students with more outdoor education experience had greater self-confidence, action skills, and generally had more environmental knowledge and empathy. Dettman-Easler and Pease (1999) found that residential (overnight) EE programs were more effective in fostering significant, positive changes in participants' attitudes toward wildlife than in-class EE programs. Gunderson (2001) described the effectiveness of a classroom-based wilderness curriculum in improving environmentally responsible behavioral intent.

The final two studies in this section examined sustained EE programs with direct connections built between outdoor experiences and the classroom. For example, Mayer-Smith, Bartosh, and Peterat (2007) studied the effects an intergenerational food growing program had on students' environmental consciousness. They found that students consistently shifted from a view of nature as object or place to a view characterized by the interconnectedness of humans and nature. A longitudinal study of an integrated EE curriculum conducted by Volk and Cheak (2003) suggested that an issues-based knowledge of the environment was an effective catalyst for pro-environmental behavior.

The last section reviewed studies of the relationship between EE programs and students' academic achievement. Emekauwa (2004a; 2004b) found that school-based, integrated EE programs in two very different regions (Louisiana and Alaska) were largely successful in closing the achievement gap for low-income and ethnic minority students by increasing GPAs, standardized

test scores, and attendance rates. Lieberman and Hoody (1998; 2000; 2005) and the NEETF (2000) found that schools using the Environment as an Integrated Context (EIC) for learning had increased standardized test scores and GPAs, reduced disciplinary incidents, and increased engagement and enthusiasm for learning for student participants. In a review of similarly defined integrated EE programs, Bartosh et al. (2006) found a significant, positive difference in student performance on standardized tests in participating schools. Lewicki (2000) reported on the positive impact a year of dedicated place-based education had on student performance on standardized tests while Basile (2000) documented children's participation in outdoor classroom curricula and its positive impact on knowledge transfer.

In the next and final chapter, the essential findings of the literature review will be summarized, critiqued, and discussed. The significance and interrelationship of the findings will be weighed in order to determine how contemporary EE programs, curricula, and experiences impact students' environmental knowledge, values, and behavior. Additionally, implications for teaching practice and considerations for future research will be described in relation to the findings.

CHAPTER FOUR: CONCLUSION

Introduction

Chapter one indicated the scope and scale of environmental and social crises facing the earth and its inhabitants. Environmental education (EE) represents one possible strategy for addressing the global, socioecological challenges posed by critical issues such as vanishing biodiversity and anthropogenic climate change. Public schools are sociocultural institutions uniquely situated to deliver widespread, transformative environmental education programs and curricula. Whether or not schools are able to pursue that promise rests in part on the outcome of the debate between proponents of environmental education and opponents who argue EE detracts from schools' primary mandate – a more narrowly defined academic agenda.

Chapter two explored the history of environmental education in the United States. While environmental education as a distinct field did not emerge until the late 1960s, its roots can be traced to the turn of the 20th century with the proliferation of three educational movements whose influences are still felt today – nature study, conservation education and outdoor education. It examined the lineage of environmental education through broad historical and social contexts and described contemporary trends in EE philosophy and practice.

Chapter three presented a critical review of current research on environmental education. The research discussed in chapter three evaluated the effects of various environmental education programs and interventions on: children's perceptions, use, and valuation of local environments; children's

environmental knowledge, values, and actions; and children's academic performance. Studies were summarized, with analysis and conclusions provided. The research was reviewed in order to determine the effectiveness of contemporary environmental education programs in promoting environmentally sustainable values and actions in their student participants.

In this fourth and final chapter, the initial research question – do environmental education programs effectively promote environmentally sustainable values and actions in their participants – will be revisited in light of the research reviewed in chapter three. An essential summary of the findings, as well as notes toward a critique of research design and methodology, will comprise the first section of this chapter. The second section will indicate the path ahead for educators seeking to deliver empowering, individually and socially transformative environmental education programs. Finally, suggestions for future research will be offered in an effort to further refine the research base and help determine the best practices in environmental education.

Summary of the Findings

Do environmental education programs effectively promote environmentally sustainable values and actions in their participants? What types of programs are most effective, and why? How do we measure students' environmental knowledge, attitudes, beliefs, or behaviors? What is the relationship between these factors? Given the unprecedented social and ecological challenges facing the earth, detailed in reports such as those produced by the Intergovernmental Panel on Climate Change (IPCC, 2007) and supported by our everyday

observations, these questions are more urgent than ever. Built on the legacy of naturalism, conservation education, and outdoor education, contemporary environmental education has promoted a social response to crises precipitated by the industrial model of social and economic organization. Educating for knowledge, values, affect, and action has helped mold and shape the field of environmental education since the 1960s. The educational movement for sustainability has, through its embodiment and expression in a diverse array of programs and pedagogies, tried to promote change toward a more socially and ecologically just world.

In order to determine which factors (socioeconomic, infrastructural, perceptual, etc.) influenced children's use and valuation of local environments, the initial studies in chapter three attempted to document the views and behaviors of children in general. To know how children's views are changed by environmental education, we have to know what views they hold. Chapter three began by establishing the connection between students' familiarity with local environments (natural and constructed) and how likely they were to use them for recreation and play. To this end, authors of the initial three studies used ecological models of analysis that incorporated both individual and environmental factors effecting decision-making. Timperio, Crawford, Telford, and Salmon (2004) examined the link between perceptions of local neighborhoods and walking and cycling among children. Their findings suggested that use was tied directly to parental and youth perceptions of safety (such as the volume of traffic and the availability of crosswalks). The credibility of the findings was harmed, in

large part, due to the authors' lack of methodological transparency regarding data collection. Furthermore, their nonrandomized sample was biased by the low response rate of self-selected participants in the study. High test-retest rate of reliability for the children's survey helped support the validity of self-reported behaviors, though, and the findings were consistent with Tandy's (1999) documentation of factors influencing the nature and location of children's play.

Tandy (1999) found that parental restrictions (based on perceptions of safety) outweighed children's preferences in determining whether they played primarily at home or in nearby nature or community. Tandy also found that low-SES students were more concerned with neighborhood safety than middle or high-SES students. Veitch, Bagley, Ball, and Salmon (2004) also examined the nature and location of children's play with particular emphasis on key social and safety factors including individual preferences and perceptions of play spaces. They, too, found that parental perceptions of safety most affected where children were allowed to play. Consistent with Tandy, this study also found that low-SES parents were more concerned with their child's safety than middle or upper-SES parents. As in all three of these studies, Veitch et al. relied exclusively on self-reported behaviors, though in this instance even further removed by narrowing interviewees to parents, only. Their findings for urban and suburban areas of Australia are consistent with earlier studies in the United States and Western Europe where perceptions of safety similarly impacted children's use of local environments (see, for example, Blakely, 1994; Valentine & McKendrick, 1997). Further research is needed to determine whether self and parent reports of

behavior are reliable and consistent (observations in addition to interviews/surveys).

The next study shifted from simple use to more explicitly pro-environmental behaviors. In accordance with the research-based conceptual model of environmental attitudes and values called the New Environmental Paradigm Scale (NEP), Evans et al. (2007) created a series of games to measure children's environmental attitudes and behaviors. They found that young children (ages 4 to 8) hold moderately high environmental attitudes and tend to behave in a manner that is ecologically responsible. However, they found little correlation between environmental attitudes and behaviors. The authors noted the difficulty of designing behavioral measures that accurately reflect the range of possible actions available to young children. This difficulty appeared throughout the literature. Questions raised by Zelezny (1999), among others, on the reliability of self-reported behavior may have impacted the findings as well.

In order to get a broad sense of how children's environmental attitudes, knowledge, and behaviors may have developed by middle school, Kuhlemeier, Berg, and Lagerweij (1999) conducted an extensive survey of over 9,000 Dutch students. The survey instruments boasted high reliability rates. For environmental knowledge, the results were similar to those expected if participants had responded randomly, suggesting that the participants' environmental knowledge was poor. However, mean scores for environmental attitudes and self-reported environmentally-responsible behavior (ERB) were positive. Analysis of the data revealed that students with greater environmental

knowledge did not report attitudes or behavior significantly different from those who scored lower on the environmental knowledge survey. A substantial relation between knowledge of environmental problems, on the one hand, and attitudes and behavior, on the other, could not be demonstrated in the study. Contradicting Evans et. al, this study found a significant correlation between environmental attitudes and behaviors. The authors also highlighted potential problems with using a survey to measure behavior in order to explain the disconnect between knowledge and behavior.

The next three studies begin to transition the literature review toward a focus on the effects of environmental education (EE) programs on participants' awareness of nature. Fisman (2005) explored the impact an environmental education program had on students' awareness of their local environment. In a pre/posttest comparison, the treatment increased student awareness of their neighborhoods, documented most strongly in a mapping activity. The design of the study was seriously flawed, however, by the lack of a control group to compare the results and isolate potential confounding effects of other independent variables (aside from the treatment). Lindemann-Matthies (2005; 2006) conducted two studies of an environmental education program that, similar to Fisman, held the goal of increasing students' awareness of local flora and fauna. Lindemann-Matthies' research benefited from a quasi-experimental pre/posttest design utilizing control and treatment groups and a much larger sample size. Post-treatment data revealed that a greater proportion of children in

classes of the experimental group increased their appreciation of wild plants and flowers.

High school students participated in Vaske and Kobrin's (2001) study of the relationship between place identity and environmentally responsible behavior. After engaging in an outdoor trail and habitat restoration program, surveys of their views and self-reported behavior showed a significant, reliable connection between place identification and environmentally responsible behavior (ERB). The connection between ERB and closeness with a particular natural place remained somewhat unclear, however, because the study did not utilize a pre/post-experimental design. In other words, students who said they felt closer to the land reported higher rates of ERB, but there was no way to determine what impact (if any) the EE program had on the development of a closer identification with place.

For the final study in the first section – Perceptions, Use, and Valuation of Local Environments – Chawla (1999) interviewed adult environmental activists to identify what life experiences may have contributed to their lives of commitment. The most often reported antecedents of environmental commitment stemmed from childhood experiences in nature, the influence of family members, membership in environmental organizations, negative experiences in nature (e.g., the effects of pollution or habitat destruction), and education. Though the study did not feature a longitudinal design or provide a control group for comparison, the phenomenological research was meant to identify patterns of life experiences that – by people's own construction of their pasts and identities –

played a significant role in their lives as environmentalists. The sample size was small (*n* = 56) but showed, across two different cultures, that formative experiences predominantly occurred during childhood. Of note to EE researchers and practitioners was the author's finding that informal experiences in nature were more often cited than more explicit educational experiences associated with schooling.

What do the findings in the first section mean, and how do they relate to the overall research question? Timperio et al. (2004), Tandy (1999), and Veitch et al. (2004) argued that parents' perceptions of the safety of local environments have the greatest impact on whether or not children are allowed to spend time independently in nearby nature or community settings. This is problematic, given the connection between place identification and environmentally responsible behavior reported by Vaske and Kobrin (2001) and the significance of formative childhood experiences in nature to adult environmental activists (Chawla, 1999). It highlights the need for environmental education programs that provide children contact with nature, exposure that increases local environmental awareness (Fisman, 2005; Lindemann-Matthies, 2005; 2006). How does awareness fuel environmentally responsible behavior? Evans et al. (2006) and Kuhlemeier, Berg, and Lagerweij (1999) produced contradictory findings; while neither study found a significant connection between environmental knowledge and environmentally responsible behavior, the second found a significant connection between attitude and ERB. This leads to a more in-depth review of the relationship between

knowledge, values, and actions fostered by environmental education programs in the next section.

The studies in the second section – Environmental Knowledge, Values, and Action – examined a wide variety of environmental education programs and their effects on participants' environmental beliefs, attitudes, and actions. EE programs reviewed had a diverse array of content, structure, duration, settings, and different sample populations. Additionally, researchers utilized a wide variety of methodologies, research instruments, and held different theoretical positions. These factors shaped data collection, analysis, and framed the conclusions they reached based on the findings. The differences in research design suggested a healthy field of literature on environmental education. However, it also revealed how contentious the definition of valid or quality research is, and that major disagreements in research design persist as modern EE prepares to enter its fifth decade.

In order to get a sense of EE research conducted before 1998, the section began by reviewing Zelezny's (1999) meta-analysis of classroom-based versus outdoor EE programs and their comparable effects on environmental behavior. In her review of eighteen studies conducted between 1971 and 1996, the author found that EE interventions in classrooms more effectively improved environmental behavior than interventions outside of classrooms. Positive environmental behaviors were linked more specifically to EE programs that actively involved participants. This finding was consistent with Knapp and Poff (2001) who found that knowledge retention of content learned through active

games dwarfed retention of content delivered in passive, lecture-based lessons. Zelezny found that only 11% of the studies measured observed behavioral changes, however, and that the quality of research conducted varied dramatically. Beyond the active/non-active variable isolated in this study, future studies focused more closely on the structure and content of EE programs.

The next group of studies investigated the effects of outdoor environmental education programs on participant knowledge, values, and behaviors. An American Institutes for Research (2005) study utilized a delayed treatment design whereby assessments of students who participated in an outdoor education program (treatment group) were compared to assessments of students whose participation in the program had not yet occurred (control group), and were then surveyed again a number of weeks later. Although the treatment group showed a significant gain in concern about conservation, it was not significantly higher than the control group. None of the other findings, including those on the EE program's impact on behavior, were found to be significant. Self-reported results on the longer-term effects showed the treatment group's views and behaviors virtually unchanged by the experience. Attempts to triangulate the data by collecting parent observations yielded data inconsistent with student self-reports.

The authors suggested the duration of the experience (five days) inhibited significant growth; however, Farmer, Knapp, and Benton (2007) demonstrated that even shorter experiences in nature can have a lasting effect on participants. They studied the long-term impacts a one-day field trip in the Great Smoky

Mountains National Park had on fourth grade students' environmental knowledge and values. One year after the field trip, student remarks during interviews showed very high percentages of recollection of ecological and environmental information. In the interviews, however, less than half of the students were found to have pro-environmental attitudes more generally. Though the sample was small (*n* = 15) and biased by the self-selection process, the study suggested that one-day outdoor education trips can have a lasting impact on students' environmental knowledge. As in the first section, the connection between knowledge and environmental attitude was challenged by the results.

Compounding the uncertainty of the relationship between knowledge, values, and actions was a similar phenomenological study conducted by Haluza-Delay (2001). She found that a twelve-day, outdoor adventure/education trip was an enjoyable and positive experience for the small group (*n* = 8) of teenagers. However, though most of the participants expressed a general concern for the environment, they did not report environmental conservation or stewardship behaviors. In her discussion of the findings, Haluza-Delay posited that programs that take participants away from their home communities to idyllic natural settings may be counterproductive to the goals of environmental education – fostering action toward environmental sustainability. In her study, participants' construction of nature as somewhere else, as other, led them to not care about (or act on behalf of) the environment where they lived. The outdoor education trip was found to reinforce or enhance this perspective.

In a third and final phenomenological study of an outdoor education experience, Knapp and Poff (2001) opined the lack of connection found between environmental knowledge and self-reported behavioral intent (stewardship or conservation actions). They studied the effects of a one-day trip to Hoosier National Forest in southern Indiana during which the fourth grade students hiked, engaged in facilitated educational activities, and participated in ranger-led discussions. One week later, surveys found moderate participant gains in environmental knowledge though, four months later, the gains had shrunk considerably. However, 96% of the students had a positive affect for the trip/site in the long-term. Despite the participants' positive recollections of the site, changes in the behavior intent category decreased dramatically from the pre-treatment survey. These findings call into question the relationship between environmental attitudes and actions, a link supported by other research reviewed in this paper (see, for example, Kuhlemeier, Berg, and Lagerweij (1999)). However, as raised by Zelezny (1999), survey-based measurements of behavior (or behavioral intent) are often made unreliable by the inapplicability of survey items for (especially young) participants.

Another unaccounted for variable that may play a significant role in the gap between environmental knowledge and/or a pro-environmental attitude, on the one hand, and environmentally responsible behavior on the other, is action competence. In other words, do children feel they have the capacity to act to protect or conserve the environment? How does action competence develop? Mogensen and Nielsen (2001) took up these questions in a broad survey of high

school-aged youth in Denmark. They used the phrase “belief in own action possibilities” (BOAP) to describe students’ self-perceived action competency. Students who stated that they had previously acted on the basis of EE had significantly higher BOAP scores. Based on this finding, the authors concluded that EE has a positive impact on students’ beliefs in their own action possibilities. However, the conclusion is over-generalized and its usefulness diminished given that no data on the type, duration, etc. of EE programs high-BOAP students participated in was provided.

Palmberg and Kuru (2000) investigated the relationship between action competence and students’ histories of participating in outdoor education programs. In a small study conducted in Finland, they selected a sample of students to observe based on survey results. While noticing clear differences between the more and less outdoor education-experienced subgroups of students regarding self-confidence, action skills, and general environmental knowledge and empathy, the distinction became less clear when assessing students’ environmentally responsible actions and skills. Needless to say, the 5:1 ratio of experienced to inexperienced students interviewed and observed in the study made for an unequal basis for comparison.

Dettman-Easler and Pease (1999) found that residential (overnight) EE programs were more effective in fostering significant, positive changes in participants’ attitudes toward wildlife than in-class EE programs. Yet, the study had many uncontrolled and unaccounted for variables: staff training and expertise, the length of residential stays, differences in content and structure of

experimental group programs, and students' prior EE experience (or simply exposure to nature or wildlife) in both the control and experimental groups. With six diverse case study programs under consideration, it was impossible to determine which factors had the biggest impact when survey results were aggregated in two over-generalized groups (treatment and non-treatment) by the authors.

In a broad study of a heterogeneous population, Gunderson (2001) surveyed the effectiveness of a wilderness and land ethic curriculum developed by the U.S. Forest Service. Though the curriculum was delivered by classroom teachers over the course of an entire school year, the researcher measured its effects on student knowledge, attitudes, and beliefs about wilderness after only the introductory lesson. Analysis of the data showed a significant difference ($p < .05$) from pre- to post-test scores for the treatment group but not the control group, the biggest gains being in the categories "Knowledge about Wilderness" and "Environmental Sensitivity." Although the study featured quasi-experimental design, the qualitative data was not verified using member checking and the study only measured self-reported behavioral intent. Nevertheless, the author concluded the study by stating that school-based wilderness education curricula can be effective in educating students on appropriate wilderness behavior.

Moving from short, isolated environmental education programs, the final two studies in this section examined sustained EE programs with direct connections built between outdoor experiences and the classroom. For example, Mayer-Smith, Bartosh, and Peterat (2007) studied the effects an

intergenerational food growing program had on students' environmental consciousness. Over the course of a school year, fifth through seventh grade students visited an urban community garden twelve times to work with elder gardeners and farmers who acted as guides and mentors. Classroom teachers integrated themes of food, farming, ecology, and sustainability across subjects to supplement the outdoor curriculum. Over five years of program implementation, the researchers found that students consistently shifted from a view of nature as object or place to a view characterized by the interconnectedness of humans and nature. However, it was unclear what part the classroom-based components of the treatment played in the development of students' eco-centric attitudes. Demographic data for participants was also absent, leaving open questions about how and whether the findings can be generalized.

Finally, Volk and Cheak (2003) reviewed the impact an integrated, school-based EE program had on students' environmental literacy. Half of the fifth and sixth grade students at a rural, public elementary school in Molokai, Hawaii took part in the Investigating and Evaluating Environmental Issues and Actions (IEEIA) curricula while the other half learned in a more traditional, textbook-oriented environment. Again, the sample self-selected into the study and little to no demographic data was presented to describe them. The results of *t* test comparisons on the Middle School Environmental Literacy Instrument showed IEEIA students outscored non-IEEIA students on five of the eight subsections of the test, though the scoring differences were significant on only three of the subtests: Knowledge of Issues, Ecological Foundations, and Self-Reported

Environmental Action. It is interesting that a significant difference in knowledge of environmental issues was found alongside self-reported environmentally responsible behavior; this suggests that an issues-based knowledge of the environment may foster pro-environmental behavior. The student data was successfully triangulated with qualitative data provided by parents, teachers, and community members.

So, what can we learn from the research reviewed in the section Environmental Knowledge, Values, and Action? Above all, we saw that the knowledge-values-action nexus is incredibly complex and, as the studies in this section showed, an individual's environmental knowledge or pro-environmental values may not necessarily lead to increased environmentally responsible behavior. Overall, the evidence showed that a wide variety of EE programs positively impact the development of environmental knowledge and values. However, the debate over the definition of environmentally responsible behavior, and the validity of instruments used to measure behavior, is fueled by the troublesome lack of support found for EE as a catalyst for stewardship or conservation action. Beginning with the studies Zelezny (1999) evaluated in her meta-analysis, the reliability of measuring environmental behaviors (or, as in Knapp and Poff (2001), behavioral intent) with self-report surveys was called into question. Some studies tried to improve the reliability of the data by incorporating observations, such as the American Institutes for Research (2005) report that included parent observations of behavioral changes.

A study conducted by Dettman-Easler and Pease (1999) examined the effectiveness of a residential EE program on participants' attitudes toward wildlife, but research design and data reporting issues clouded their results beyond usefulness. Gunderson (2001) investigated the effects of the introductory lesson of a classroom-based wilderness education curriculum on (among other variables) students' behavioral intent toward wilderness. Though the study showed promising results for the treatment group, follow-up studies on how the curriculum impacted actual behavior are necessary to validate the findings. The one-day outdoor education trip researched by Farmer, Knapp, and Benton (2007) found that while such experiences can positively impact participants' environmental knowledge, the connection between increased knowledge and a positive disposition toward nature is uncertain. Given a similar outdoor education experience, Knapp and Poff (2001) were surprised to learn that participants moderately increased knowledge and highly positive attitude toward the forest site were paired with an actual decrease in reported environmentally responsible behavior. Similarly, Haluza-Delay (2001) found no connection between positive environmental attitudes and self-reported environmentally responsible behavior following a longer outdoor education trip. The American Institutes for Research (2005) report on an outdoor education trip concluded that, in the long term, the experience had virtually no effect on participant views or behavior.

Mogensen and Nielsen (2001) introduced the concept of action competence to the literature review, and found a strong connection between students' action competence and their previous participation in EE programs.

Looking at the effects of experience in outdoor education programs on action competence, Palmberg and Kuru (2000) determined that more experienced students demonstrated greater environmental knowledge and empathy, but did not generally behave in more environmentally responsible ways. Longer-term programs that integrated fieldwork with classroom-based instruction, such as those studied by Mayer-Smith, Bartosh, and Peterat (2007) and Volk and Cheak (2003) found a strong connection between EE programs and the development of eco-consciousness and environmental literacy (including, for Volk and Cheak, environmental behavior). The promising findings of these last two studies suggest the need for further research on long-term, integrated EE programs' effects on participant knowledge, values, and actions.

No Child Left Behind shapes the terrain that schools, educators, curricula, and students occupy. As such, despite a growing mandate, the viability of EE's place in public education has less to do with the socioecological crises facing the earth than whether EE can improve student academic achievement. Most of the studies in this section narrowly defined academic achievement as increased standardized test scores or grade point averages. The studies were all quantitative and, because of the widespread availability of data, generally had much larger sample sizes than studies in the previous two sections. The ability to document increased student performance on widely-accepted (widely-enforced?) measures is of keen interest to environmental education advocates. It lends legitimacy to the inclusion or integration of EE into public school classrooms everywhere. Therefore, beyond reviewing literature on the ability of EE to

promote sustainable attitudes and actions in its student participants, the literature on EE and academic performance was considered.

Emekauwa (2004a) studied the impact district-wide implementation of a place-based learning initiative had on academic performance. East Feliciana Parish in rural, southeastern Louisiana undertook a district-wide reform process, Project Connect, that integrated place-based environmental education throughout curricula. Quantitative data revealed a shrinking performance gap between the district and state for all subject areas in the years following Project Connect's implementation, as measured by 4th grade students' scores on a statewide standardized test. The results were particularly noteworthy due to the demographically diverse and overwhelmingly low-SES student population in East Feliciana Parish. A clearer account of all aspects of the reform process, including increased teacher training, needs to be provided in order to determine what aspects of Project Connect account for improved student performance.

Emekauwa (2004b) also researched the effects a state-wide place-based learning initiative had on the performance of rural students throughout Alaska. The Alaska Rural Systemic Initiative (AKRSI) was a broad-based, state-wide education reform program that sought to develop pedagogical practices and curricula that were culturally compatible with indigenous knowledge systems and relevant to daily life in poverty-stricken rural areas. By measures such as standardized test scores, drop-out rates, and first-time college enrollment, the AKRSI reform has improved student performance across the state of Alaska. However, the data showed inconsistencies. For example, gains made on the

number of students passing the High School Qualifying Examination at AKRSI schools were outpaced by non-AKRSI rural schools and the state gains as a whole.

Lieberman and Hoody (1998; 2000; 2005) designed several studies to identify, describe, and analyze the effectiveness of integrated environment-based educational programs. Specifically, they identified schools that adhered to guidelines created by the State Education and Environment Roundtable (SEER), a consortium that includes twelve state education agencies, to use as bases for comparison with more traditional schools. Overall, they found that schools using the Environment as an Integrated Context (EIC) for learning boasted increased standardized test scores and GPAs, reduced disciplinary incidents, and increased engagement and enthusiasm for learning versus non-treatment comparison schools or their previous performance. Their studies had a variety of problems, however. In Lieberman and Hoody (1998), the presentation of quantitative data was purely descriptive and offered no mention of statistical significance or reliability. In Lieberman and Hoody (2000), the validity of comparisons between treatment and non-treatment schools was left doubtful by the lack of a clear, systemic process for choosing the non-treatment sample schools. In Lieberman and Hoody (2005), however, full disclosure of an unbiased sampling procedure and clearer presentation of data analysis improved the study a great deal. Although all three studies showed positive results for EIC-based learning programs, EIC as a designation identifies constructivist-based teaching practices, interdisciplinary curricular design strategies, and more that go way

beyond the simple inclusion of EE into curricula. Therefore, the studies seem more a validation of constructivist-based teaching practices than EE in general. To be fair, that was partially the authors' intent: to advocate for a specific type of integrated EE program, including those practices, implemented on a school-wide basis.

The National Environmental Education and Training Foundation (NEETF, 2000) studied the effects school-wide adoption of integrated, environment-based education had on academic achievement and disciplinary incidents. This study, too, selected a sample based on the EIC criteria developed by SEER. The NEETF selected four case studies in states throughout the country to compare students in EIC-based programs with non-EIC comparison students on measures such as standardized tests (e.g., the Iowa Test of Basic Skills). While the EIC sample schools were ethnically and socioeconomically diverse, very little demographic data was provided for the comparison schools. Due to the heterogeneity of the EE programs developed and implemented at each of the case study schools, the question of what exactly positively impacted student performance remains unclear. Also, no measurement of the significance of data was given.

Similar to the four previous studies, Bartosh, Tudor, Ferguson and Taylor (2006) researched the impact of integrated environmental education on student achievement on standardized tests. They compared student scores on the Washington Assessment of Student Learning (WASL) between 77 pairs of schools with integrated environmental education (EE) programs and those with

more traditional curricula. The rubrics developed in the selection of the treatment sample schools were very similar in structure and content to those developed by SEER. Selection of comparison schools was transparent and unbiased. The authors found that EE schools consistently outperformed traditional schools on the WASL test. The mean percentages of students who met standards on the WASL were higher in EE schools in every subject. The results were found to be significant and reliable. Even though this study featured a much better design than those conducted by Lieberman and Hoody (1998; 2000; 2005) and the NEETF (2000), the authors' conclusions were much more modest in scope; given the number of unknown variables, they found a pattern relationship between integrated EE programs and improved student achievement.

Lewicki (2000) reported on the impact a year of dedicated place-based education had on student performance on standardized tests. The school's structure and curricula, described by the study's author (who was also the founder and a faculty member of the school) as a pedagogy of place, included 100 days of field studies dedicated to exploring local history, ecology, and culture in settings in diverse local natural and community settings. A small sample of first-year students were given the Iowa Test of Educational Development at the beginning of a school year and the end, and were found to have made gains on every section of the test – including a composite score (all subjects combined) that increased by nearly three grade levels. However, data analysis was unclear. No attempt was made to discern what aspects of the school's program (i.e.,

which independent variables) produced student gains for the dependent variable (ITED scores).

Basile (2000) documented children's participation in outdoor classroom curricula and its impact on knowledge transfer. Knowledge transfer is a unique and important concept among the studies reviewed in this section. Basile was the only researcher who attempted to expand the definition of learning beyond the narrow confines of test scores to look at students' ability to apply declarative, procedural, and schematic knowledge in different contexts. The study utilized a nonrandomized pretest/post-test design which improved the reliability of the results. One third grade teacher taught two groups of students two different seven-week science programs. The treatment program was based on principles (many of them included as selection criteria in studies throughout this section) such as inquiry-based, interdisciplinary instruction rooted in students' interests and concerns, and included a one-day trip to a nature center. The control group was given a more traditional, passive, textbook-driven science curriculum. The treatment group tested significantly higher on measures of transfer of procedural and schematic knowledge.

Studies in this final section – Academic Performance – consistently found evidence of the systematic relationship between contact with nature (structured through a variety of EE programs and approaches) and improved student learning and academic performance. Or did they? As indicated in the review of the literature, researchers chose to broadly define environmental education in their sampling procedures. This lead to studies (NEETF, 2000; Lieberman and

Hoody, 1995; 2000; 2005) showing widespread gains in academic performance for students in schools that not only taught environmental education, but incorporated a whole array of practices based on constructivist learning theory. While studies of improved academic achievement in ethnically diverse, low-SES schools show great promise (Emekauwa 2004a; 2004b), it is unclear which aspects of their broad reforms account for the improvements. Looking over the literature, as Bartosh et al. (2006) found, what emerges is a pattern of improved academic performance in schools with integrated environment-based education programs.

Classroom Implications

The scope and scale of social and environmental crises are ever-expanding and intensifying. The modern environmental education movement has the potential to actively involve educators, children, and their communities in an effort to confront socioecological challenges a with profound hope for a more just, sustainable future. While environmental education has grown over the past four decades, spreading throughout the world in a diverse array of articulations, it has become increasingly contentious. Who defines environmental education? How should it be practiced? How can its benefits be weighed or measured? What is its place in public education here in the United States?

Based on recent national polling data, an overwhelming mandate for environmental education in public schools exists (Roper-Starch, 2000). National polling data also suggests widespread discontentment with the brave new world of education reform ushered in by No Child Left Behind and its proponents (Rose

and Gallup, 2007). But in the standards-based reform climate created by NCLB, the perceived conflict over curricular space and time has been exacerbated; teachers feel pressured, above all, to increase students' standardized test scores (Mabry, Poole, Redmond, & Schultz, 2003).

What can educators learn from the research on how best to incorporate environmental education into their curricula, and what benefits can they reasonably expect? Beginning with the findings of studies like Timperio et al. (2004), Tandy (1999), and Veitch et al. (2004), teachers can be assured that children's independent access to nearby nature and community spaces is diminishing. As articulated in the Tbilisi Declaration (Intergovernmental Conference on Environmental Education, 1971), environmental awareness is the first step on a path toward positive environmental values and actions. Research supporting this link between identification with place and environmentally responsible behavior is slim but promising (Vaske and Kobrin, 2001). If students are not able to come into contact with local environments on their own, schools can play a vital role by providing opportunities to do so. Studies by Lindemann-Matthies (2005; 2006) and Fisman (2005) suggested that EE programs that put children into contact with nearby nature and community improve students' awareness of local environments. It is clear that EE can increase the opportunities, and thus the chances, that lives will take an environmentally responsible form. But what about children's perceptions of, and attitudes toward, the environment?

Some studies have found that children generally hold positive views of the environment (Kuhlemeier et al., 1999; Evans et al., 2007). Others have demonstrated that outdoor education programs, such as active trips to parks, forests, or nature centers, can increase student appreciation of the environment (Farmer et al., 2007; Knapp and Poff, 2001; Palmberg and Kuru, 2000; Dettman-Easler and Pease, 1999). Researchers have demonstrated that classroom-based environmental education can positively impact students' attitudes toward the environment, as well (Zelezny, 1999; Gunderson, 2001). Additionally, long-term involvement in EE programs that integrate fieldwork and classroom-based studies show strong improvement in pro-environmental attitudes (Mayer-Smith et al., 2007; Volk and Cheak, 2003).

In the past, environmental educators assumed that if they imparted enough knowledge to students then responsible action would follow. However, qualitative research has shown that antecedents of environmentally responsible action are much more complex. Haluza-Delay (2001) found no connection between pro-environmental attitudes and pro-environmental behaviors; Knapp and Poff (2001) found that, as attitudes toward the environment improved, environmentally responsible behavior actually decreased. Other studies found little connection between environmental knowledge and attitudes (Farmer et al., 2007). This leaves educators in the uncertain position of trying to determine what types of environmental education activities will inspire pro-environmental attitudes and catalyze action for sustainability.

Given the pressure on teachers and students to continually improve academic performance, it is promising to see a great deal of literature linking environmental education to achievement in diverse settings and populations. At the classroom (Lewicki, 2000), school (Lieberman and Hoody, 1998; 2000; 2005; NEETF, 2000) district (Emekauwa, 2004a), and state (Emekauwa, 2004b) levels, a consistent pattern of increased student achievement emerges. All of the reviewed studies on EE and academic achievement investigated programs that entailed much more than the inclusion of environmental content. Indeed, the literature clearly showed that that these were integrated, place-based education programs that included significant shifts in pedagogy and practice (Bartosh et al., 2006).

Some of the broader, common threads that emerged included increased professional development opportunities for teachers, interdisciplinary curricular design and lesson planning, differentiated instruction and assessment practices, and a greater emphasis on conceptual and problem-based instruction. Throughout the literature review, it became clear that many environmental educators and EE researchers incorporated these elements of reform into their definition of environmental education. Though it falls outside of the scope of this paper's research question, the literature on these aspects of educational reform and pedagogy is vast. Teachers should review literature on these topics in order to gain a clearer, less ambiguous picture of the types of academic achievement related outcomes they can expect by implementing any of the various programs,

practices, or curricula included under the broad umbrella of environmental education.

The raison d'être of educators in the public school system is the success of their students. How is that success defined? In the final analysis, despite the weak design issues of numerous studies reviewed in this paper, the tentative conclusion reached here is that public education can, and should, encompass both the development of humans passionately engaged in the enjoyment and stewardship of the environment as well as ensuring their academic achievement. Studies have shown that a wide variety of EE programs have the capacity to help students grow and develop toward these ends. Educators must Whether it is adopting (and adapting) a curriculum, implementing some of the pedagogical or curricular changes described, or integrating lessons on (and in) nearby nature and community, environmental education has the potential to help teachers fulfill their mandate in the broadest possible sense.

Suggestions for Further Research

It is telling that all of the qualitative studies reviewed throughout this paper focused on environmental knowledge, values, and behavior, while all of the studies on academic achievement were quantitative. As described in chapter one, these two distinct areas of research mirror the political schism between those who view environmental education primarily as a means to create a more just, sustainable world and those who see mainstreamed EE as an opportunity to help students succeed in the current system. The measures are different because the subjects are different, as are the goals. In the meantime, we are left

wondering: are they mutually exclusive, or can programs strive toward multiple goals at the same time? None of the studies included data on environmental knowledge, attitudes, and behaviors as well as academic achievement. In order to begin to determine the holistic effects of environmental education, a new path of comprehensive mixed method research that incorporates all of these outcomes should be pursued.

Future qualitative studies can be improved by the practice of member checking. Most of the authors' interpretations of data gathered from observations, interviews, and surveys were never verified by the subjects. Despite widespread concern regarding the validity of survey instruments used to measure behavior, many of the studies relied on survey data to do so. An overarching concern is that all of the actions listed as survey items may not be available to the subjects, which detracts from the reliability of the results. Evans et al. (2007) developed age-appropriate measurements (in this case, games) with high test-retest reliability scores, and their efforts to develop more accurate instruments should be expanded upon. The second concern with behavioral results is that they were typically self-reported. While some studies gathered data from multiple sources (triangulation) in order to improve the reliability of the findings (Volk and Cheak, 2003), the literature would benefit from longitudinal studies of observed behavioral changes in order to address reliability concerns that arise with self-reporting.

Haluza-Delay (2001) advanced a critique of past EE research design as being overwhelmingly behaviorist. Her solution, focusing on students'

construction of nature and their experiences, merits further discussion and may hold some clues as to why (and whether) students choose to engage in environmentally responsible behavior. Similarly, action competence (Palmberg and Kuru, 2000) adds another dimension to the exploration of how knowledge and attitudes may not be enough to enable pro-environmental behavior. Larger and more diverse samples may improve the transferability of findings.

Quantitative studies could be improved by clearer, more transparent data gathering and analysis procedures. Some studies omitted tests (or results) of statistical significance or reliability (Lewicki, 2000; Gunderson, 2001). While a small handful of studies showed marked improvement in sampling procedures (Bartosh et al., 2006), most of the studies reviewed did not include enough demographic data to ensure appropriate comparisons (Lieberman and Hoody, 1998) which may have resulted in biased samples. The findings of other studies were clouded by the inability of researchers to account for or analyze a wide variety of variables independent of the treatment that may have confounded the results (Emekauwa, 2004b). When studying a broad program of school reform like Project Connect (Emekauwa, 2004a), what role did the professional development workshops and conferences teachers participated in play in improving students' academic achievement?

In other words, some of the treatments seemed too broadly or heterogeneously defined, the authors unable (or unwilling) to parse out which aspects of EE programs, curricula, and experiences played the most significant roles in expanding environmental knowledge, fostering positive environmental

values, catalyzing environmentally responsible action, or simply improving academic achievement. Often, these research design issues did not arise mysteriously, without intention or acknowledgement on the part of the researchers. For example, Lieberman and Hoody (1998; 2000; 2005) designed studies intended to provide support for a specific interpretation and practice of EE that feeds an unambiguous agenda for national school reform in the United States. As they plainly state, “EIC-based learning is not primarily focused on learning about the environment, nor is it limited to developing environmental awareness” (1998, p. 4). If environmental education is no longer about the environment, what then does it consist of? For Lieberman and Hoody (1998), it is based on core educational strategies such as team teaching, interdisciplinary lesson planning, and highly differentiated, conceptual and problem-based instruction.

Above all, it is clear that the definition of environmental education remains intensely political. In order to determine what factors effect which outcomes – in other words, what teaching and learning practices make a difference to students – further in-depth research that accounts as much as possible for the entire teaching and learning environment is needed.

Conclusion

Chapter one indicated the scope and scale of environmental and social crises facing the earth and its inhabitants. Environmental education (EE) represents one possible strategy for addressing the global, socioecological challenges posed by critical issues such as vanishing biodiversity and

anthropogenic climate change. Public schools are sociocultural institutions uniquely situated to deliver widespread, transformative environmental education programs and curricula. Whether or not schools are able to pursue that promise rests in part on the outcome of the debate between proponents of environmental education and opponents who argue EE detracts from schools' primary mandate – a more narrowly defined academic agenda. Limitations of this paper, as well as a definition of terms used throughout, were also provided.

Chapter two explored the history of environmental education in the United States. While environmental education as a distinct field did not emerge until the late 1960s, its roots can be traced to the turn of the 20th century with the proliferation of three educational movements whose influences are still felt today – nature study, conservation education and outdoor education. It examined the lineage of environmental education through broad historical and social contexts and described contemporary trends in EE philosophy and practice.

Chapter three presented a critical review of current research on environmental education. The research discussed in chapter three evaluated the effects of various environmental education programs and interventions in three separate categories. Studies in Perceptions, Use, and Valuation of Local Environments found that children's independent access to nearby nature and community spaces is diminishing, and that environmental education programs are capable of expanding children's awareness of the environment. Studies in Environmental Knowledge, Values, and Actions overwhelmingly found that a wide variety of environmental education programs are capable of increasing

students' environmental knowledge and improving their attitudes toward the environment. Additionally, studies found that the presence of pro-environmental knowledge or attitudes did not necessarily result in increased environmentally responsible behavior. Overall, studies in Academic Performance found that students in integrated environment-based education programs experience greater academic achievement than students in more traditional settings, or show significant improvement over past performance. The research was reviewed in order to determine the effectiveness of contemporary environmental education programs in promoting environmentally sustainable values and actions in their student participants.

In chapter four, the initial research question – do environmental education programs effectively promote environmentally sustainable values and actions in their participants – was revisited in light of the research reviewed in chapter three. An essential summary of the findings, as well as notes toward a critique of research design and methodology, comprised the first section of the chapter. The second section indicated the path ahead for educators seeking to deliver empowering, individually and socially transformative environmental education programs. Based on the findings, educators were urged to seize upon the growing public enthusiasm for environmental education and expand their definitions of student success beyond academic achievement to include helping children and youth become passionate defenders of the earth who are prepared to grapple with the challenges of social justice and sustainability. The research indicated a wide variety of EE programs and approaches with the capacity to

help teachers in this effort. Finally, suggestions for future research were offered in an effort to further refine the research base and help determine the best practices in environmental education. These suggestions included: more comprehensive mixed method studies that incorporate knowledge, values, action and academic achievement; using practices like member checking and triangulation to verify qualitative findings; developing age-appropriate, reliable instruments to measure environmentally responsible behavior; better, more transparent data collection and analysis procedures; larger, more demographically diverse samples; and more in-depth studies of teaching and learning environments that can account for as many independent variables as possible in order to determine which aspects of EE programs and curricula have the greatest positive impacts.

This paper takes the position that the evidence of environmental and social crises necessitates a broad-based, collective response that identifies and addresses fundamental causes of these challenges by providing children (and their communities) with opportunities to develop knowledge and values to act for sustainability and social justice. Does environmental education have the power to transform our cultural and ecological relationships from the grassroots – beginning with the knowledge, values, and actions of children growing in our communities? The research collected and reviewed in this paper has shown that environmental education has the capacity to foster positive attitudes toward the environment as well as the ability to cultivate environmental knowledge. The connection to action, though vital, is less clear. Further research and continued

experimentation in the field are necessary to actively involve educators, youth, and their communities in meeting the great socioecological challenges of our times as part of a broader movement toward social justice and sustainability.

References

American Institutes for Research. (2005). *Effects of outdoor education programs for children in California.* Retrieved December 1, 2007 from http://www.sierraclub.org/youth/california/outdoorschool_finalreport.pdf.

Basile, C. (2000). Environmental education as a catalyst for transfer of learning for young children. *Journal of Environmental Education, 32*(1), 21-27.

Bartosh, O., Tudor, M., Ferguson, L. & Taylor, C. (2006). Improving test scores through environmental education: Is it possible? *Applied Environmental Education and Communications, 5*, 161-169.

Berry, W. (2000). *Life is a miracle: An essay against modern superstition.* Washington, D.C.: Counterpoint Press.

Blakely, K. (1994). Parents' conceptions of social dangers to children in the urban environment. *Children's Environments, 11*(1), 16-25.

Blumenthal, R. (2006, January 13). Houston ties teachers' pay to test scores. *The New York Times.*

Bögeholz, S. (2006). Nature experience and its importance for environmental knowledge, values and action: Recent German empirical contributions. *Environmental Education Research, 12*(1), 65-84.

Bowers, C.A. (1995). *Educating for an ecologically sustainable culture.* Albany, NY: SUNY Press.

Bowers, C.A. (2001). *Educating for eco-justice and community.* Athens, GA: University of Georgia Press.

Cajete, G. (1994). *Look to the mountain: An ecology of indigenous education.* Durango, CO: Kivakí Press.

Carson, R. (1962). *Silent spring*. New York: Harper and Row.

Chawla, L. (1998). Significant life experiences revisited: A review of research on sources of environmental sensitivity*. The Journal of Environmental Education, 29*(3), 11-21.

Chawla, L. (1999). Life paths into effective environmental action. *The Journal of Environmental Education, 31*(1), 15-27.

Clayton, M. (2004, September 2). Voracious earth: Some regions – especially in Asia – are overusing their renewable resources. *The Christian Science Monitor*.

Cole, A. G. (2007). Expanding the field: Revisiting environmental education principles through multidisciplinary frameworks. *The Journal of Environmental Education*, *38*(2), 35-44.

Comstock, A. B. (1911). *Handbook of nature study.* Retrieved February 9, 2008 from http://www.archive.org/details/handbookofnature002506mbp.

Cushman, J. (1997, April 22) Critics rise up against environmental education. *The New York Times.*

Dailey, R. (2007). *Dustbowl created desert*. Retrieved February 16, 2008 from http://desertgardens.suite101.com/article.cfm/1934_dustbowl_created_desert

Dettmann-Easler, D. & Pease, J. (1999). Evaluating the effectiveness of residential environmental education programs in fostering positive attitudes toward wildlife. *Journal of Environmental Education*, *31*(1).

Disinger, J. (2001). *North American association for environmental education. Thirty years of history, 1971-2001*. Retrieved December 22, 2008 from http://naaee.org/aboutnaaee/naaeehistory2001.pdf.

Emekauwa, E. (2004a). *They remember what they touch: The impact of place-based learning in East Feliciana parish.* Retrieved August 2, 2008 from http://www.peecworks.org/PEEC/PEEC_Research/S0009D4FB.

Emekaua, E. (2004b). *The star with my name: The Alaska rural systemic initiative and the impact of place-based education on native student achievement.* Retrieved August 2, 2008 from http://eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED484828&ERICExtSearch_SearchType_0=no&accno=ED484828.

Engleson, D. (2008). *About environmental education: Wisconsin history.* Retrieved December 22, 2008 from http://www.uwsp.edu/CNR/waee/AboutEE/wihistory.aspx.

Evans, G., Brauchle, G., Haq, A., Stecker, R., Wong, K. & Shaprio, E. (2007). Young children's environmental attitudes and behaviors. *Environment and Behavior, 39*(5), 635-659.

Farmer, J., Knapp, D. & Benton, G. (2007). An elementary school environmental education field trip: Long-term effects on ecological and environmental knowledge and attitude development. *The Journal of Environmental Education, 38*(3), 33-42.

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

Gadotti, M. (2003). *Pedagogy of the earth and culture of sustainability.* Retrieved February 12, 2008 from http://www.paulofreire.org/Moacir_Gadotti/Artigos/Ingles/On_Education/Pedagogy_of_the_Earth_and_Culture_of_Sustainability_2003.pdf.

Gardner, G.T. & Stern, P.C. (2002). *Environmental problems and human behavior.* Boston: Pearson Custom Publishing.

Glenn, J. (2000). *Environment-based education: Creating high performance schools and students.* Retrieved February 10, 2008 from http://www.neefusa.org/resources/publications.htm#eepubs.

Gruenewald, D. (2003a). Foundations of place: A multidisciplinary framework for place-conscious education. *American Educational Research Journal, 40*(3), 619-654.

Gunderson, K. I. (2001). An evaluative study of the "Wilderness & Land Ethic" curriculum. Ph.D. dissertation, University of Minnesota, United States – Minnesota. Retrieved December 14, 2008, from Dissertations & Theses: A&I database. (Publication No. AAT 3010553).

Haluza-Delay, R. (2001). Nothing here to care about: Participant constructions of nature following a 12-day wilderness program. *The Journal of Environmental Education, 32*(4), 43-8.

Independent Commission on Environmental Education (ICEE). (1997). *Are we building environmental literacy? A report by the independent commission on environmental education.* Retrieved May 14, 2008 from http://www.marshall.org/article.php?id=10#execsum.

Intergovernmental Conference on Environmental Education. (1977). *The Tbilisi Declaration.* Retrieved December 4, 2007 from http://www.gdrc.org/uem/ee/tbilisi.html.

Intergovernmental Panel on Climate Change (IPCC). (2007). *Climate change 2007.* Retrieved February 11, 2008 from http://www.ipcc.ch.

Jackman, W. (1892). *Nature study for the common schools.* New York: Henry Holt and Company.

Kahn, R. (2008). Towards ecopedagogy: Weaving a broad-based pedagogy of liberation for animals, nature, and the oppressed people of the earth. In A. Darder, M. Baltonado, & R. Torres (Eds.), *The critical pedagogy reader* (2nd ed.). New York: Routledge.

Knapp, D. & Poff, R. (2001). A qualitative analysis of the immediate and short-term impact of an environmental interpretive program. *Environmental Education Research, 7*(1), 55-65.

Kuhlemeier, H., Bergh, H. & Lagerweij, N. (1999). Environmental knowledge, attitudes, and behavior in Dutch secondary education. *Journal of Environmental Education, 30*(2).

Lewicki, J. (2000). *100 days of learning in place: How a small school utilized "place based" learning to master state academic standards.* Washington, D.C.: Rural School and Community Trust.

Lieberman, G. & Hoody, L. (1998). *Closing the achievement gap: Using the environment as an integrating context for learning.* Poway, CA: SEER.

Lieberman, G. & Hoody, L. (2000). *California student assessment project phase one: The effects of environment-based education on student achievement.* Poway, CA: SEER.

Lieberman, G. & Hoody, L. (2005). *California student assessment project phase two: The effects of environment-based education on student achievement.* Retrieved December 1, 2007 from http://www.seer.org/pages/research/csapII2005.pdf.

Lindemann-Matthies, P. (2005). 'Lovable' mammals and 'lifeless' plants: How children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education, 27*(6), 655-77.

Lindemann-Matthies, P. (2006). Investigating nature on the way to school: Responses to an educational programme by teachers and their pupils. *International Journal of Science Education, 28*(8), 895-918.

Mabry, L., Poole, J., Redmond, L. & Schultz, A. (2003). Local impact of state testing in southwest Washington. *Education Policy Analysis Archives, 11*(21). Retrieved August 7, 2008 from http://epaa.asu.edu/epaa/v11n22/.

Maffi, L. (2001). On the interdependence of biological and cultural diversity. In L. Maffi (Ed.), *On biocultural diversity: linking language, knowledge, and the environment* (p. 1-50). Washington, D.C.: Smithsonian Institution Press.

Mayer-Smith, J., Bartosh, O. & Peterat, L. (2007). Teaming children and elders to grow food and environmental consciousness. *Applied Environmental Education and Communication*, *6*, 77-85.

Medina, J. (2008, March 5). Next question: Can students be paid to excel? *The New York Times.*

Mogensen, F. & Nielsen, K. (2001). Students' knowledge about environmental matters and their belief in their own action possibilities – a Danish study. *Journal of Environmental Education, 33*(1), 33-35.

Millennium ecosystem assessment. (2005). *Ecosystems and human well-being: Synthesis*. Washington, D.C.: Island Press.

National Commission on Excellence in Education (NCEE). (1983). *A nation at risk.* Retrieved February 11, 2008 from http://www.ed.gov/pubs/NatAtRisk/index.html.

Nelson, G. (1980). *Earth day '70: What it meant.* Retrieved December 22, 2008 from http://www.epa.gov/history/topics/earthday/02.htm.

Orr, D. (1994). *Earth in mind.* Washington, D.C.: Island Press.

Palmberg, I. & Kuru, J. (2000). Outdoor activities as a basis for environmental responsibility. *The Journal of Environmental Education, 31*(4), 32-36.

Palmer, J. (1997). Beyond science: Global imperatives for environmental education in the 21st century. In P. Thompson (Ed.), *Environmental education for the 21st century: International and interdisciplinary perspectives* (p. 3-11). New York: Peter Lang Publishing.

Palmer, J. (1998). *Environmental education in the twenty-first century.* London: Routledge.

Population Connection. (2002). *Population and the Environment*. Retrieved May 11, 2008 from http://www.populationconnection.org/Reports_Publications/Reports/report209.html.

Pyle, R. (2001). The rise and fall of natural history. *Orion, 15*(1), 17-23.

Rogoff, B. (2003). *The cultural nature of human development.* New York: Oxford University Press.

Roper-Starch Worldwide. (2000). The national report card on environmental knowledge, attitudes and behaviors: The ninth annual survey of adult Americans. Washington, DC: National Environmental Education and Training Foundation.

Rose, L. & Gallup, A. (2007). *The 39th annual Phi Delta Kappa/Gallup poll of the public's attitudes toward the public schools.* Retrieved August 7, 2008 from http://www.pdkintl.org/kappan/k_v89/k0709pol.htm.

Roy, A. (1999). *The Greater Common Good.* Delhi, India: India Book Distributors.

Smith, D. & Williams, R. (Eds.). (1999). *Ecological education in action: On weaving education, culture, and the environment.* Albany, NY: SUNY Press.

Sivek, D. (2002). Environmental sensitivity among Wisconsin high school students. *Enviromental Education Research, 8*(2), 155-170.

Sobel, D. (1998). *Mapmaking with children: Sense-of-place education for the elementary years.* Portsmouth, NH: Heinemann.

Sobel, D. (2002). *Children's special places.* Detroit: Wayne State University Press. (Original work published 1993).

Sobel, D. (2004). *Place-based education: Connecting classrooms & communities.* Great Barrington, MA: The Orion Society.

Spring, J. (2008). *The American school: From the puritans to no child left behind.* New York: McGraw-Hill.

State Education and Environment Roundtable. (1995a). *Pieces of a puzzle: an overview of the status of environmental education in the U.S.* Retrieved December 1, 2007 from http://www.seer.org/pages/research/pieces.pdf.

State Education and Environment Roundtable. (1995b). *The educational efficacy of environmental education.* Retrieved December 1, 2007 from http://www.seer.org/pages/research/educeff.pdf.

Tandy, C.A. (1999). Children's diminishing play space: A study of intergenerational change in children's use of their neighbourhoods. *Australian Geographical Studies, 37*(2), 154-64.

Timperio, A., Crawford, D., Telford, A., & Salmon, J. (2004). Perceptions about the local neighborhood and walking and cycling among children. *Preventive Medicine, 38,* 39-47.

Turner, W., Nakamura, T., & Dinetti, M. (2004). Global urbanization and the separation of humans from nature. *BioScience, 54*(6), 585-590.

United Nations Population Fund (UNFPA). (2001). *State of World Population*. Retrieved May 11, 2008 from http://www.unfpa.org/publications/.

United Nations Population Fund (UNFPA). (2007). *State of World Population.* Retrieved May 11, 2008 from http://www.unfpa.org/publications/.

United Nations World Commission on Dams (UNWCD). (2000). *Dams and development.* Retrieved May 7, 2008 from http://www.unep.org/dams/documents/default.asp?documentid=469.

Valentine, G. & McKendrick, J. (1997). Children's outdoor play: Exploring parental concerns about children's safety and the changing nature of childhood. *Geoforum, 28*(2), 219-235.

Vaske, J. & Kobrin, K. (2001). Place attachment and environmentally responsible behavior. *The Journal of Environmental Education, 32*(4), 16-21.

Veitch, J., Bagley, S., Ball, K., & Salmon, J. (2006). Where do children usually play? A qualitative study of parents' perceptions of influences on children's active free-play. *Health & Place, 12,* 383-93.

Vernadsky, V.I. (1998). *The biosphere.* (D. Langmuir, Trans.). New York: Springer. (Original work published 1926).

Volk, T. & Cheak, M. (2003). The effects of an environmental education program on students, parents, and community. *The Journal of Environmental Education, 34*(4), 12-25.

Wheeler, G. & Thumlert, C. (2007). *Environmental Education Report.* Olympia, WA: OSPI.

Woodhouse, J. (2001). Over the river and through the 'hood: Re-viewing place as focus of pedagogy. *Thresholds in Education, 57*(3-4), 1-5.

Zelezny, L.C. (1999). Educational interventions that improve environmental behaviors: A meta-analysis. *The Journal of Environmental Education, 31*(1), 5-15.