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Environmental Literacy of Sixth Grade Students in Arkansas: Implications for Environmental Education Reform

Lisa Suzanne Wood
University of Arkansas, Fayetteville

ENVIRONMENTAL LITERACY OF SIXTH GRADE STUDENTS IN ARKANSAS: IMPLICATIONS FOR ENVIRONMENTAL EDUCATION REFORM

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IMPLICATIONS FOR ENVIRONMENTAL EDUCATION REFORM

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By

Lisa S. Wood
University of Arkansas
Bachelor of Science in Agronomy, 1984
University of Arkansas
Master of Science in Agronomy, 1988

December 2013
University of Arkansas

This dissertation is approved for recommendation to the Graduate Council.

____
Dr. Cathy Wissehr
Dissertation Director

____
Dr. Michael Wavering
Committee Member

____
Dr. William McComas
Committee Member

____
Dr. George Denny
Committee Member

Abstract

Environmental education must be better integrated into K-12 curriculum to advance environmental literacy. Producing a citizenry that can understand and address the complex environmental issues facing the world today and in the future is essential to sustainable life on this planet.

Using the Middle School Environmental Literacy Survey, 6^{th} grade students across Arkansas were surveyed to obtain a baseline measure of environmental literacy based on the four domains of environmental literacy included in the survey; ecological knowledge, environmental affect, cognitive skills, and behavior. Individual domain scores were combined into a composite environmental literacy score. Results were then compared to the national baseline established by the National Environmental Literacy Assessment Project. The research population consisted of a stratified random sample of 6^{th} grade students across Arkansas. An ex post facto research design was used to analyze the sample.

The results of the research indicated that the Arkansas 6^{th} grade students scored in the moderate range for the domains of ecological knowledge, environmental affect, and behavior. However, scores for cognitive skills were in the low range. The mean composite environmental literacy score indicated the 6^{th} grade students had a moderate level of environmental literacy overall. Students in Arkansas scored significantly lower (t (4110) = 15.41, p = <0.01) than the students in the national survey on overall environmental literacy. Statistically significant differences were identified based on physiographic region of the state, geographic region of the state, and students' self-reported level of contact with the outdoors.

Despite their noting it is important to expose students to environmental education, teachers who completed the program information surveys indicated none of the schools had an

environmental education component in the delivered curriculum. Surveys from individual teachers indicated they received little to no training in environmental education during pre-service teacher preparation programs and little to no on-going professional development related to environmental education.

To ensure overall environmental literacy in Arkansas, this research indicated that we must improve students' cognitive skills and ensure teachers have the content knowledge and pedagogical strategies to effectively integrate environmental education across the curriculum.

Acknowledgements

A research project as robust as this is not possible without the help of many. I am thankful to the administrators at the 40 schools who welcomed us into their schools and granted us access to their students. Without their belief that improving environmental literacy in the K-12 environment is crucial to the future of our existence, this project would not have been possible. Thank you to the 60 teachers who took time out of their busy schedules to orchestrate the data collection and to honestly and openly share their thoughts on environmental education through completed surveys. Most especially, thanks are due to nearly 3,500 6th grade students who were willing to take the survey so soon after benchmark testing. The students, the teachers, and the administrators made this study possible.

Reading the Scantrons and preparing the data set for analysis would have been much more difficult and time consuming without the help of expert assistance of Ling Ting who coded all the data for analysis and John Paul Jackson who wrote the program to read the Scantron sheets, scanned all the sheets, and created the initial text file. My sincere thanks go to both of you. Thanks to Marsha West and Rick Ward who collected student data. Marsha spent a week on the road in southwest Arkansas and Rick spent a week on the road in southwest and central Arkansas. Without their willingness to help in a significant way, I could not have met the data collection schedule required based on student availability.

Special thanks to my committee members, William McComas, Michael Wavering, Cathy Wissehr, and the late George Denny (who left us much too soon). The committee sets the tone for a dissertation project and this committee was enthusiastic, interested, and actively involved in the process from beginning to end. I thank each of you for your guidance, advice, and encouragement throughout this journey. Special thanks to Bill for taking a chance on me, a middle-aged woman, with no formal teaching experiences and admitting me to the Science Education program. Your guidance is the glue that keeps the Science Education students together and I appreciate the opportunities you have given me along the way. Special thanks also to Cathy for serving as my Dissertation Director and guiding me through this research project. Your encouragement, leadership, and compassion for working with your students are amazing. Thank you for giving of so much of your time. Thanks are also due to Dr. Elizabeth Keiffer who stepped in and helped me with the statistics after the loss of Dr. Denny. I am grateful for your willingness to assist during the awkward transition following George's death.

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Rachel Carson said "If a child is to keep alive his inborn sense of wonder, he needs the companionship of at least one adult who can share it, rediscovering with him the joy, excitement and mystery of the world we live in." Thanks to Matthew and Michael Wood who embody the reasons I turned my professional interests from environmental consulting to teaching others and sharing with others my joy and excitement of the outdoor world in which we live. I want you to always have that sense of wonder and awe that keeps you connected with nature. And I will be at least one of the adults who will share it with you. Thanks for inspiring me to work toward a sustainable planet for you. Thanks to my brother, Dan, a teacher, a deep thinker, and a lover of the outdoors. You are also a great inspiration to me. Thanks for your encouragement and discussions along the way. Thanks also to Melissa, my sister-in-law, for her support and encouragement throughout this process. And last, but not least, a heartfelt thank you to my parents, Chester and Susan Wood, who not only loved me and encouraged me throughout this process but also came from Ohio to travel the highways and byways of Arkansas for three weeks collecting student data. Never hesitating when asked, they gave of their time and resources to help make this project a success. I could not have done it without them! I am truly blessed!

Dedication

To

Elizabeth Baiter Sahnd, my grandmother

1920-2012

Her quiet enthusiasm and unwavering interest in my

educational pursuits were a great motivation to me

and

To

George S. Denny

1957-2013

A devoted teacher, mentor, and friend whose passion

for working with students will be sorely missed

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Chapter 1 Introduction

Statement of Problem

In 1990, a working group of environmental educators identified the need for research on the status of environmental literacy among K-12 students, post-secondary students, pre- and in-service teachers, and the general public (Wilke, 1990). Others have also called for research to assess the environmental literacy of students (McBeth, 1997; National Council for Science and the Environment, 2008; National Environmental Education Advisory Council, 2005; Saunders, Hungerford & Volk, 1992; Wilke, 1995). Assessments of environmental literacy are an important source of information (Hollweg et al., 2011) but are relatively new because, until recently, no clear operational definition of environmental literacy existed. Additionally, there are no large-scale assessments like the National Environmental Literacy Assessment (NELA) and the Program for International Student Assessment (PISA) used to measure environmental literacy.

The NELA used a research-based instrument (Hungerford, Volk, McBeth, & Bluhm, 2009) to measure the baseline environmental literacy for 6^{th} and 8^{th} graders (McBeth et al., 2008). The findings were used to evaluate the status of environmental literacy among middle school students across the United States. The results indicated further research should be undertaken to identify the factors contributing to the disparities found in the measured variables. The researchers also noted the middle school students were at both ends of the continuum of scores, including high and low levels of environmental literacy among them. A thorough review of programs at the high and low ends of the continuum might reveal attributes responsible for the observed disparities.

How do Arkansas students rank as compared to the national baseline assessment data? Are our elementary and middle school programs achieving the goals and objectives of environmental literacy as outlined in the Tbilisi Declaration (UNESCO, 1978)? Prior to this study, no Arkansas statewide assessment of environmental literacy of middle school students existed.

The No Child Left Inside Act of 2011 (NCLI) (S. 1372-112th Congress) sought to amend the Elementary and Secondary Education Act of 1965 to require states to develop environmental literacy plans for preK-12 that include the development of environmental education standards and teacher education as a prerequisite to receiving implementation grants. If passed, the NCLI Act would provide $100 million in funding for state environmental education efforts. The NCLI Act emphasized the role of outdoor education; integrated environmental education into formal schooling in an interdisciplinary manner; and required the development of state environmental education standards, assessment, and teacher training through statewide environmental literacy plans to be adopted by state boards of education (H.R. 2547, 2011). Many states developed environmental literacy plans in anticipation of the passage of the Act. Although an environmental literacy plan was under development in Arkansas, it was not completed after the NCLI Act failed to pass during its first introduction to Congress. It is difficult to conceive of the development of an effective statewide environmental literacy plan without an understanding of the Arkansas baseline of environmental literacy across the measured constructs as well as an understanding of how students compare to the national norms.

A gap in the literature is evident related to the identification of specific factors or attributes at the regional, school, teacher, and student levels that may be most predictive of the students' level of environmental literacy. Influences may include a variety of school attributes, teacher attributes, and student attributes or an interaction of these attributes.

Background of Study

The need for education about the environment has been noted by educators and activists for over a century. Rachel Carson's book, *Silent Spring*, intensified the need for environmental education by bringing concerns of environmental degradation through the use of pesticides to the public eye (1962). Society's ever-increasing concern about environmental quality and its interrelationships with human health and welfare from local to global scales helped fuel the modern-day environmental education movement which began in the 1960s and 1970s. The major environmental issues impacting people today demonstrate the need to create a more environmentally literate citizenry better able to make choices that benefit our present and future.

Environmental issues typically considered on a local level include such concerns as wetlands protection and development, disposal of hazardous waste, solid waste management, the challenges of invasive plant and animal species, and sources of non-point source pollution. Regional issues often include groundwater extraction and pollution, natural gas extraction by fracking, sustainable farming, concerns with species diversity and protection, and water quality of a region's rivers and lakes. National issues of concern are expanded to include carbon dioxide and other greenhouse gas emissions, climate change, widespread drought, population and land use, and the degradation and depletion of our natural resources, including soil. Finally, on a global scale, environmental concerns include, but are not limited to, global climate change, world food supplies, deforestation, air pollution, and equitable distribution of food and water supplies, energy, and other resources.

Global issues have become increasingly important as the world gets "smaller" and environmental impacts in one part of the world affect those in other parts of the world. The economic, political, and social pressures created by continuing exponential growth in human populations lead to increased competition for the world's resources needed to sustain the standard of living to which we have become accustomed and life itself. Disagreements about how to best approach these issues are already challenging current scientific, social, and political systems (Hollweg et al., 2011). To prepare people to understand and address complex environmental issues, educators must improve environmental literacy worldwide. An environmentally literate public will be necessary for finding scientifically-based solutions to the complex environmental problems increasing daily. This literate citizenry must understand basic ecological principles, appreciate and care for the environment, possess the skills to identify and analyze critical environmental issues, and share a willing commitment to sustainability (Stevenson, Peterson, Bondell, Mertig, & Moore, 2013).

The concept of environmental literacy has grown out of the historical definitions and goals of environmental education. The United Nations Conference on the Human Environment was held in Stockholm in 1972 and called for the United Nations Educational, Scientific, and Cultural Organization (UNESCO) to proactively develop a program for promoting environmental education around the world (Stapp, 1979). At a workshop held in Belgrade in 1975, the Belgrade Charter was adopted. The goal, as stated in the Charter, also became the present-day definition of environmental education:

> The goal of environmental education is: to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. (UNESCO_UNEP, 1976, p. 2)

This statement was expanded during the 1977 Intergovernmental Conference on Environmental Education which produced the Tbilisi Declaration, a seminal document in environmental education. In this document (UNESCO, 1978), the goals of environmental education were quoted as follows:

- To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural settings;

- To provide every person with opportunities to acquire knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;

- To create new patterns of behavior of individuals, groups and society as a whole towards the environment (pp. 26-27).

Five categories of environmental education objectives were also identified including:

- Awareness: to help social groups and individuals acquire an awareness of, and sensitivity to, the total environment and its allied problems;

- Knowledge: to help social groups and individuals gain a variety of experience in, and acquire basic understanding of, the environment and its associated problems;

- Attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection;

- Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems;

- Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems (pp. 26-27).

These objectives serve as the basis for developing a framework for assessing environmental literacy even today. "When these categories of objectives are viewed in the context of the Tbilisi goals, they represent stepping stones to prepare and enable citizens, including students, to become actively involved in the prevention and resolution of environmental problems and issues" (McBeth, et al., 2008, p. 2).

Despite the potential importance of environmental literacy in understanding and addressing global environmental crises now and in the future, little empirical research has been conducted to address how environmental literacy is attained (Keene & Blumstein, 2010). Researchers from the North American Association for Environmental Education (NAAEE), as part of the National Environmental Literacy Assessment Project (NELA), sponsored by the United States Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) developed a research instrument for measuring key components of environmental literacy in 6^{th} and 8^{th} grade students (Hungerford et al., 2009).

The first national baseline assessment was conducted in 2006 with findings published in 2008 (McBeth et al., 2008). The survey instrument measured the following environmental literacy components: (a) ecological knowledge; (b) environmental affect which includes verbal commitment – intention to act, environmental sensitivity, and general environmental feelings; (c) cognitive skills which include issue identification, issue analysis, and action planning; and (d) behavior which represents actual commitment or pro-environmental behavior. The NELA project provided future researchers with a standardized measure of environmental literacy for middle grade students, developed the first major assessment tool evaluate students in the United States, and provided a baseline against which future assessments can be measured. However, little research has been conducted to measure all four components or domains of environmental literacy and evaluate potential drivers of environmental literacy, specifically on a statewide or regional basis.

The results of the national baseline study indicated that, as a group, the 6^{th} and 8^{th} graders sampled scored at moderate to high levels in their ecological understandings. Their attitudes were moderately positive, particularly in terms of positive feelings toward the environment and willingness to take positive actions to protect and improve the environment. Older students were more knowledgeable and skilled at issue identification and decision-making than were younger students. However, the younger students appeared to have more positive feelings and a greater willingness to take positive actions as well as a higher level of participation in pro-environmental behaviors. Older students did not report undertaking actual behaviors to remediate environmental problems/issues despite their reported verbal commitment to do so. Additionally, critical thinking and decision-making skills were found to be low for the younger group.

The NELA study was undertaken specifically to provide a baseline against which to compare future measures. McBeth et al. (2008) encouraged the use of the instrument for more state-specific and programmatic assessments so that comparisons could be made to the national assessment data. There is a scarcity of research evidence about environmental literacy and, prior to the McBeth et al. (2008) milestone study of, there was no benchmark against which results could be compared. Based on the findings of this research, McBeth et al. (2008) stated there has been a development of research-based national frameworks for assessing environmental literacy and sound educational practices toward advancing environmental literacy. Regular and systematic measurement is now needed to assess progress on both local and regional scales.

Purpose of Study

The purpose of this ex post facto research study was to conduct an assessment of 6th grade students across Arkansas using the Middle School Environmental Literacy Survey (MSELS) previously developed by researchers and used for the nationwide assessment conducted during the 2006-2007 school year (McBeth et al., 2008). The researchers granted permission for its use under specified conditions (see Appendix A) and provided 3,500 instrument booklets for the student assessment. Initially, the data from Arkansas 6th grade students were aggregated to determine, on a statewide basis, the levels of environmental literacy for individual components and as a composite environmental literacy score. The results from the Arkansas assessment were then compared to the nationwide assessment to determine the level of environmental literacy in Arkansas 6th graders as compared to 6th graders across the nation. The data were disaggregated to compare groups of independent variables at the state level, school level, teacher level, and student level to determine predictors of environmental literacy.

Research Questions

This study sought to answer the following questions:

Research Question 1: What is the level of environmental literacy of sixth grade students across Arkansas on the following variables included in the MSELS and how do these findings compare to the national baseline data with respect to:

a) Ecological knowledge;
b) Verbal commitment;
c) Actual commitment;
d) Environmental sensitivity;

e) General environmental feelings;

f) Environmental issue identification;

g) Issue analysis; and

h) Action skills.

Research Question 2: What are the composite levels of environmental literacy of 6th grade students across Arkansas and how do these findings compare to the national data?

Research Question 3: To what degree does the environmental literacy of students across Arkansas differ and/or correlate based on the following school-level demographic information:

a) Physiographic and geographic regions of state;

b) Sixth grade total enrollment (less than 50 students, 50-100 students, and greater than 100 students);

c) Socio-economic status (based on total percentage free and reduced lunch);

d) Locale;

e) School organization (elementary versus middle, teacher organization, and curriculum organization); and

f) Science and literacy benchmark test scores.

Research Question 4: To what degree do the levels of Arkansas students' environmental literacy differ based on teachers' self-reported demographics, use of environmental education curriculum and pedagogical strategies?

Research Question 5: To what degree is there a correlation between environmental literacy and the students' self-reported level of engagement in outdoor activities? Further, to what degree does the availability of an outdoor classroom and/or community garden on school grounds and the teachers' reported usage of that space impact the students' environmental literacy?

Research Question 6: What are the differences and similarities assessed by the survey between the three highest performing schools and the three lowest performing schools on this environmental literacy survey?

Significance of Study

The overall goal of this study was to evaluate the current status of environmental literacy in 6^{th} grade Arkansas students and to determine programmatic and instructional changes that need to be implemented to advance environmental literacy statewide. This study is important to environmental educators in Arkansas both at the state and local school levels because it provides a direct measure of the four domains of environmental literacy as well as an overall evaluation of students' environmental literacy. When compared to the national baseline assessment data, the results of this study can be used to evaluate the effectiveness of the environmental education programs in Arkansas. This study also serves to provide data identifying regions of the state and specific schools that need improvement in their environmental education curriculum based on low levels of environmental literacy. By comparing the environmental literacy findings of the top performing schools and the lowest performing schools, attributes contributing to the environmental literacy were identified. These results can be used to make recommendations for environmental education reform in Arkansas.

If this same group is tested again in 8th grade, it would provide an indication of growth in environmental literacy by these students. Those results could help inform individual school districts as well as the state about the effectiveness of their environmental education programs. Having an Arkansas baseline of environmental literacy against which to compare future findings is invaluable to the environmental education program statewide.

Scope of Study

The MSELS was used with a stratified random sample representing approximately 10 percent of the 6th graders enrolled in public schools in Arkansas during the 2012-2013 school year. The stratified random sample was sorted by zip code to assure equitable coverage across the state and by 6th grade enrollment to assure equal representation of small, medium, and large schools. Only those public schools with 6th grade classes were eligible to be selected for participation in the study. Participating schools included both elementary and middle schools. The MSELS measured eight variables (see Research Question # 1) critical to evaluating environmental literacy. Data collected by researchers during the national baseline assessment were used as a basis for comparison.

Limitations

The population studied was representative of 6th grade students across Arkansas based on 6th grade enrollment numbers at the schools, geographic coverage, and the ethnic and gender make-up of the 6th graders statewide. Securing the administrator's approval to conduct the study at the randomly selected schools was a limitation to the study. Schools were reluctant to participate based on past experiences with researchers, the benchmark testing schedule, and other end-of-year time constraints. The stratified random selection of schools was modified based on the willingness of administrators to participate in the study. Scheduling conflicts within the school environment and student absenteeism posed another limitation. Students were participating in other school activities outside their regularly scheduled classes and some schools had unusually high absenteeism rates because it was the end of the school year and benchmark testing was completed. Test fatigue on the part of the students may have also posed a limitation. Students were asked to give the survey 100% effort and attention. However, many students expressed verbally they were less than enthusiastic to participate because they had just completed a week of benchmark testing and were tired of "taking tests." Another limitation was the presence of special needs children mainstreamed within the classrooms. I had not taken into consideration their presence and their need to have a teacher or paraprofessional read the surveys to them. Though most teachers were willing to make the accommodation I had overlooked, there were some students who struggled to read the survey on their own who likely failed to understand the material and likely did not finish. Similarly, the teachers were asked to complete the Teacher Information Form and Survey as thoroughly and honestly as possible. Teacher fatigue or concern with representing curriculum in a positive light is another potential limitation to the study.

Delimitations

This study was limited to 6th grade students enrolled in public schools throughout Arkansas during the 2012-2013 school year. For practical and financial reasons, the number of schools selected for sampling purposes was limited to forty. Environmental literacy has been defined in a number of ways with varying components (Simmons, 1995 & Wilke, 1995). Only those components included in the MSELS were assessed in this study. Eight specific conceptual variables were measured in the MSELS – ecological knowledge, verbal commitment or intention to act, environmental sensitivity, environmental feelings, issue identification, issue analysis, action planning, and actual commitment or pro-environmental behavior. These eight conceptual variables combine to form the four domains or components of environmental literacy including ecological knowledge, environmental affect, cognitive skills, and behavior. The four domains combine to form an overall environmental literacy level. No other environmental literacy components were surveyed.

The survey was administered to the students for a time period that generally did not exceed one class period (45-50 minutes). A number of schools provided a longer time period for students who did not read as well as the other students surveyed. Data collection was specifically planned for the end of the school year so that direct comparisons could be made between the environmental literacy of students in Arkansas and the students in the national baseline study who were also assessed at years end.

Definition of Key Terms

There is no single universally accepted definition of ***environmental education*** (Disinger, 1983). Any definition is subject to discussion, debate, and interpretation and there is the hazard of using the term 'environmental education' to represent an array of activities that do not reflect the appropriate principles and characteristics (Marcinkowski, 1990, p. 9).

Definitions most often referenced by environmental educators today are from drafts of the Belgrade Charter and the Tbilisi Declaration which produced the following goals for environmental education:

- To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural settings;

- To provide every person with opportunities to acquire knowledge, values, attitudes, commitment and skills needed to protect and improve the environment; and

- To create new patterns of behavior of individuals, groups and society as a whole towards the environment. (UNESCO, 1978, pp. 26-27)

The definition of environmental education has continued to evolve in recent years, although the Belgrade Charter and Tbilisi documents still serve as the cornerstone for such refinements. The categories of objectives include awareness, knowledge, affect, skills, and participation. When considered collectively, they provide a means by which students and adults alike can become actively involved in the identification, prevention, and solution of the cadre of complex environmental issues present in the world.

For the purposes of this study, environmental education will be defined as education in, for, and about the environment for the purpose of accomplishing the objectives as set forth by the Tbilisi Declaration and described above.

The objectives were formulated into frameworks for environmental literacy during the 1990s (Simmons, 1995). Among other characteristics, ***environmental literacy*** involves people in seeking connections between objects and events, evaluating the consequences of potential actions, and acting responsibly as one form of living thing among many diverse, interacting, and interrelated forms (Roth, 1992). Environmentally literate persons have knowledge of issues, action strategies, and a sense of responsibility (Hungerford, Peyton, & Wilke, 1981). This study recognizes and uses the definitions provided by NELA (McBeth et al., 2008) as adapted from Simmons, 1995). Four conceptual variables or domains of environmental literacy are referred to in this study. The first is ***ecological knowledge***. This domain focuses on knowledge of major ecological concepts and knowledge and understanding of how natural systems work. It also focuses on how natural systems interface with social systems. The second domain is ***environmental affect*** which is based on factors within individuals that allow them to reflect on environmental problems and issues at an intrapersonal level and act on them if they judge the problem/issue warrants action. Conceptual variables used to measure environmental affect on the MSELS included verbal commitment or intention to act, environmental sensitivity, and environmental feelings. ***Cognitive skills***, the third domain of environmental literacy, are defined as one's ability to analyze, synthesize, and evaluate information about environmental problem/issues on the basis of empirical evidence and personal values. Cognitive skills also include one's abilities to select appropriate action strategies and to create, evaluate, and implement action plans. The fourth and final domain identified in this study is ***environmentally responsible behavior***. To be considered literate in terms of behavior one must engage in active and meaningful participation in solving problems and resolving issues. Categories for environmentally responsible action include persuasion, consumer action, eco-management, political action, and legal action.

Chapter II Literature Review

Introduction

The purpose of this study was to assess the environmental literacy of 6th grade students across Arkansas using the Middle School Environmental Literacy Survey (MSELS) developed by Hungerford et al. (2009). This chapter presents a review of the literature associated with the historical background and development of environmental education and the theoretical background of environmental literacy. Research-based assessments of environmental literacy were reviewed based on prior research studies and trends with a specific focus on the National Environmental Literacy Assessment Project: Year 1, National Baseline Study of Middle Grade Students (McBeth et al., 2008). The literature reviewed in this chapter provides a robust summary of the history of environmental education, demonstrates the development of the environmental literacy construct, and establishes the need for further assessment of the environmental literacy of students.

Pertinent literature was identified using a variety of search engines including EbscoHost, Google Scholar, ERIC Database, and ProQuest. As literature was reviewed, additional readings were identified through a review of citations within the material accessed.

Developing and Defining Environmental Education – Politically and Historically

In order to properly discuss the development of a definition for and characteristics of environmental literacy, as well as to defend the importance of developing environmental literacy through school curricula, it is first necessary to review the literature summarizing the development of environmental education itself. Environmental education is currently experiencing a period of exponential growth, a result of widespread global environmental issues, changing social expectations, and educational reform (Hart, 2007). While, to some, environmental education appears to be a relatively new concept in modern society resulting from increased interest in environmental problems and issues, environmental education is an important part of the history and culture of the United States. The Native Americans revered mother Earth and thought it was important to teach future generations about her.

> Teach your children what we have taught our children that the earth is our mother. Whatever befalls the earth, befalls the children of the earth. If we spit upon the ground, we spit upon ourselves. This we know. The earth does not belong to us: we belong to the earth. (Chief Seattle, 1855; cited in Gingrich, 1988, p. 303)

Other early writings addressed concerns about human interaction with nature – Emerson's *Nature* (1836), Thoreau's *Walden* (Krutch, 1962), and George Perkins Marsh's *Man and Nature* (1864). The writings continued into the twentieth century with writers such as John Muir, Enos Mills, and Aldo Leopold. The emphasis in these writings was primarily on resource conservation and habitat preservation rather than environmental quality and environmental awareness (Carter & Simmons, 2010).

The years following World War II led to a focused movement to protect the environment by both individuals and the government. Some of the landmark events for this period include:

- 1948 – The Conference for the Establishment of the International Union for the Protection of Nature (IUNC) - protection of nature and habitats were top priorities;
- 1949 – Aldo Leopold wrote *A Sand County Almanac* which became a cornerstone of the American environmental movement;
- 1962 – Rachel Carson's *Silent Spring* documented the negative and widespread impact of pesticides like DDT; awakened the American public to important environmental issues;

- 1963 – Steward Udall's *The Quiet Crisis* provided readers with insight into what had already been lost and what could be lost due to impending environmental threats.

The 1960s also saw a tremendous increase in environmentally-focused legislation in the United States, a rate and volume that would be exceeded only in the 1970s (Carter & Simmons, 2010). Some key legislation included: Wilderness Act of 1964 (Pub L 88-577), Species Conservation Act of 1966 (Pub L 89-669), Wild and Scenic River Act of 1968 (Pub L 90-542), Solid Waste Act of 1965 (Pub L 89-272), and Clean Air Act of 1965 (Pub L 88-206).

As a result of the raised level of public awareness and additional new legislation, 1970 was a landmark year for the environmental movement in the U.S. (Carter & Simmons, 2010):

- The National Environmental Policy Act of 1969 went into effect January 1, 1970 and remains in effect today. The statement of purpose reads "to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation." (42 U.S.C. 4321)
- April 22, 1970, the first Earth Day was celebrated and involved an estimated 20 million people with participation on 1,500 college campuses across the United States (Rome, 2003).
- National Science Teachers Association (NSTA) conducted a study that showed schools needed an environmental education program and associated curriculum development. In an address to Congress, President Nixon stated "It is also vital that our entire society develop a new

understanding and a new awareness of Man's relation to his environment – what might be called "environmental literacy." This will require the development and teaching of environmental concepts at every point in the education process." (Nixon, 1970, p. vii)

- October 1970 – National Environmental Education Act was signed into law by Richard Nixon (Public Law 9-516)

The need to strengthen environmental education was also becoming more recognized internationally during the 1970s. Nations began to work together. At the time, no single definition of environmental education existed in the literature. A significant contribution to these international efforts was the development of a commonly accepted working definition and guiding principles for environmental education. The international working meeting on environmental education in the school curriculum, sponsored by the World Conservation Union (IUCN) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) developed the classic definition of environmental education as:

> 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 a code of behavior about issues concerning environmental quality (IUCN, 1970).

Definitions most often referenced by environmental educators today are from drafts of the Belgrade Charter (UNESCO, 1976) and the Tbilisi Declaration (UNESCO, 1977) which produced the following goals for environmental education:

- To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural settings;

- To provide every person with opportunities to acquire knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;
- To create new patterns of behavior of individuals, groups and society as a whole towards the environment. (UNESCO, 1978, pp. 26-27)

The definition of environmental education continued to evolve beyond the 1970s, although the Belgrade Charter and Tbilisi documents still serve as its cornerstone. Harde (1984) defined environmental education as follows, "Environmental education in its broadest sense, is the designation used to refer to all forms of facilitating learning and disseminating knowledge about the environment and humanity's impact upon it." (p. 40)

The momentum for environmental education waned under the presidency of Ronald Reagan in the 1980s. He eliminated nearly all funding appropriated by the Nixon Environmental Education Act of 1970. It has been suggested that Reagan was indifferent toward environmental quality and literacy. An anti-environmental movement, the Wise Use movement, developed during his presidency (Kline, 2007). The group, which formed in 1988, promoted that public lands should be used for mining and drilling (extractive purposes) as well as grazing and logging (utilitarian purposes) which are for the sake of human benefit. The movement advocated that these land-uses should have precedence over any ecological, scenic, wildlife or aesthetic land-uses (Helvarg, 1994). The election of George H. W. Bush in 1988 led to a revision of the National Environmental Education Act of 1970 which was re-authorized in 1990. Throughout his presidency (1989-1993) and the Clinton years (1993-2001), the United States saw a gradual re-embracing of environmental concerns and the need for environmental education (Warren, 2003).

The North American Association for Environmental Education (NAAEE) initiated the development of guidelines for environmental education in 1993. The initiative became known as the National Project for Excellence in Environmental Education and today provides guidelines for the development of environmental education materials as well as benchmarks for practitioner and student environmental knowledge (NAAEE 2004a, b, c).

In 1996 the U.S. EPA's Office of Environmental Education published the following definition of environmental education:

> Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teachers individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action. (Federal Register, Tuesday, December 10, 1996, p. 65106)

The 2001 reauthorization of the Elementary and Secondary Education Act (also known as No Child Left Behind [NCLB]) supported standards-based educational reform on the premise that setting high standards and establishing measurable goals would improve individual learning outcomes. Each state was charged with developing assessments in basic skills for the students within their respective states. The assessments at select grade levels are required for states to receive federal funding. No Child Left Behind ignored environmental education and failed to reinstate the National Environmental Education Act of 1990 (Carter & Simmons, 2010). As a result, there was, once again, a decreased emphasis on environmental education and an increased effort to improve students' scores on standardized tests instead. Despite this decreased emphasis, some educators and researchers continued to promote and document the importance of having children learn about the environment. Interest once again increased when researchers began espousing the benefits of children interacting with the natural environment.

The No Child Left Inside movement which began in 2005 after the publication of Richard Louv's *Last Child in the Woods: Saving Our Children from Nature Deficit Disorder*, raised awareness for education in and about the environment, including getting the children outdoors to experience the nature. Though not passed to date, approval of NCLI (H. R. 2547, 2011) would be a re-authorization of the National Environmental Education Act. As proposed, the act would require states to develop environmental literacy plans for Pre-K through 12, including environmental education standards and teacher training.

Science and environmental education are woven together in the sense that both relate to human and animal life, how nature works, and how technology impacts the world (Plevyak & Mayfield, 2010). The following modern definition of environmental education insists educators must help students understand environmental issues based on scientifically sound information:

> . . . increasing public awareness and knowledge about environmental issues and providing the skills necessary to make informed decisions and taking responsible action. It is based on objective and scientifically sound information. It does not advocate a particular viewpoint or course of action. It teaches individuals how to weigh various sides of an issue through critical thinking and it enhances their own problem-solving and decision making skills. (US EPA 2008, ¶ 2)

Growth of Interest in Nature, Conservation, and Outdoor Education

Carter and Simmons (2010) posit that environmental education is a "discrete discipline with identifiable roots and unique characteristics" (p. 11). The growth of interest in environmental education has been noted by numerous people since the beginning of the twentieth century. Disinger (1985) identifies three predecessors to environmental education: nature study, conservation education, and outdoor education. Brice (1973) wrote "The antecedents of contemporary environmental education can be traced to the nature study movement which developed during the latter part of the 19th century and dominated early childhood education until the 1920s." (p. 3). Nature study was the first true science curriculum in the United States. It incorporated nature and inquiry-based teaching (McComas, 2008).

In 1891, Wilbur Jackman wrote *Nature Study and the Common School* in which he stressed the importance of learning from the surrounding environment. Bailey and Comstock developed nature study curriculum in the late 1800s and early 1900s (Comstock & Gordon, 1939). In 1911, Anna Comstock wrote *Handbook of Nature Study*, originally designed for elementary teachers who knew little about the environment. It is a field guide to all living things (but humans) and non-living things such as rocks and minerals, weather, and the stars. She approached the handbook from the standpoint that one should know the things closest to him or her before journeying farther. This curriculum was used until the early 1920s when the *Cardinal Principles of Secondary Education* was adopted by educators. This document changed the structure of education in the United States. Nature study no longer fit into secondary education. However, based on new objectives, some schools did develop camping programs (Hammerman, 1978).

Early in the 1900s, the conservation movement became popular. This movement began largely in response to the damage of natural resources by settlers in the West. During the period of western settlement, forests had been cleared for agriculture, destroyed by lumbering, and lost to forest fires. Soils were subjected to erosion and depletion of nutrients from poor management. The grasslands were overgrazed and wildlife had been hunted to excess resulting in depletions of buffalo, deer, elk, and antelope. As a result of these widespread destructive forces, interest in conservation and preservation of natural environments grew (Person, 1989).

Many people contributed to the conservation movement of the early twentieth century, including President Theodore Roosevelt. Gifford Pinchot, the first director of the United States

Forest Service who served under President Roosevelt, believed that nature existed to be used by man for the greatest good of the greatest number of people (the utilitarian perspective). John Muir, geologist and founder of the Sierra Club advocated that nature deserves to exist for its own sake regardless of its usefulness to us (the biocentric preservation perspective). His philosophy of nature protection was formed by aesthetic and spiritual values (Cunningham & Cunningham, 2012).

Early conservation curricula closely followed the view of conservation proposed by Aldo Leopold, who argued for stewardship of the land. He wrote *A Sand County Almanac* (1949), a collection of essays about our relationship with nature. He wrote, “We abuse land because we regard it as a commodity belonging to us. When we see land as a commodity to which we belong we may begin to use it with love and respect” (Forward, p. ix). Two other books had a tremendous impact on raising the awareness of environmental problems related to pesticide use and unchecked air and water pollution. These included Rachel Carson’s *Silent Spring* (1962) and Stuart Udall’s *The Quiet Crisis* (1963). These publications sparked the modern day environmental movement that began in the 1960s. As a result of increased awareness of problems and issues related to the environment, significant environmental legislation was enacted during that era including the Endangered Species Act (1966) and the Clean Air Act (1965). Paul Ehrlich (1968) extended the concern over the environment in a book titled *The Population Bomb* in which he pointed to overpopulation as an environmental concern claiming it would result in a direct threat to human survival and the integrity of the environment.

The goal of conservation education was to awaken Americans to environmental problems and the importance of conserving various natural resources (Nash, 1976). Roth (1978) noted that the conservation education movement originated in large measure from a governmental base. As environmental problems increased, governmental agencies were created to deal with the issues. The U.S. Forest Service and the Environmental Protection Agency were two such agencies. The creation of these agencies resulted in a stepwise approach to solving environmental problems. The first was usually legislation, then enforcement, and then the realization that education was needed so that people would understand the need for such legislation, willingly obey the laws, and see the environmental value in both.

Outdoor education became another of the roots, or foundations, for environmental education. L.B. Sharp (1943), a pioneer in outdoor education, defined outdoor education as a method or climate for learning. He saw outdoor education as an interdisciplinary approach to more effective and efficient learning. One way to integrate the curriculum was through the use of outdoor educational opportunities. While some educators saw (and still see) informal educational opportunities as less important than formal classroom instruction, outdoor education is rooted in the philosophy, theory, and practices of experiential learning.

In a book titled *Fifty Years of Resident Outdoor Education, 1930-1980, Its Impact on American Education*, William Hammerman (1980) chronicles the historical developments and the impact of outdoor education curriculum development on students from 1930 through 1980. Long before classrooms, textbooks, or professional educators emphasized the merits of environmental education, Hammerman pointed out, learning by direct experience was the method of passing on the essentials of human culture (Hammerman, 1978). Organized camping began in the late nineteenth and early twentieth centuries. An early account of school camping in this country was reported in 1918 where students at an intermediate school in Los Angeles developed a camp site by clearing the ground and erecting crude log cabins. Students used the camp both during the school year and also summer vacation. In 1919, a resident outdoor camp was established by the Chicago Public Schools. It was organized through the regular school program and funded by the Board of Education. In 1925, the U.S. Forest Service and the Los Angeles school board sponsored a forestry camp in California. The camp was geared toward teaching high school boys sound conservation practices and proper forest management. These earliest developments in U.S. outdoor education were isolated experiences carried out as much for recreation and developing a healthy lifestyle (through leisure activities) as for the potential educational opportunities they generated. However, these initial projects set the stage for what would become a clearly defined movement in education.

Today there are thousands of outdoor education programs across the nation for both children and adults. The programs and facilities are sponsored by elementary and secondary schools, colleges and universities, youth camps, churches, municipal recreational departments, non-profit organizations and even private entrepreneurs and philanthropists. Despite the widespread usage of these facilities as key educational components of instruction, there is no nationally standardized outdoor education curriculum and no standardized measure of outdoor education competency and knowledge (Ford, 1986).

However, the concept of “outdoor education” has come far since those early days described by Hammerman (1980). Many opportunities exist for educating children outdoors at science centers and environmental education centers where formal curriculum is presented within the context of the outdoors. If properly planned and executed, these meaningful experiences outside the classroom can complement and augment classroom learning. The words of John Dewey (1900) still echo the value of outdoor education more than a century later, “Experience outside the school has its geographical aspect, its artistic and its literary, its scientific and its historical sides. All studies arise from aspects of the one earth and the one life lived upon it." (p. 91)

Development of the Environmental Literacy Concept and Definitions

The concept of environmental literacy was allegedly first developed by Roth in 1968 and began as a written response to a description of student protesters who were labeled as "environmentally illiterate" (Nelson, 1996). Roth (1992) provided an early definition as follows:

> Environmental literacy involves human discourse about inter-relationships with the environment. It is essentially the degree of our capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems. (p. 17)

Rillo (1974), in his writings, referred to the concept of environmental literacy but never specifically defined it. He did, however, provide a working definition:

> Environmental literacy on the part of the general public could precipitate pressure to slow down the pace of environmental change until the consequences can be scientifically, psychologically, and socially determined. Technology may be a major cause of the contemporary environmental predicament, but it is only one of the major causes, and it has the capability of solving the problems it creates. An environmentally aware and articulate citizenry could very well be the catalyst for technology's acceptance of its responsibility for quality in the living environment. After all, the public is the consumer of technology's productive effort. . . The major objective of environmental education is aimed at producing an individual who is motivated toward the rational use of the environment in order to develop the highest quality of life for all…An individual should have adequate understanding of the biophysical world including both the biosphere (natural environment) and the psychosphere (the man-made environment) and the role of these resources in contemporary society. He should have an understanding of how to identify environmental problems, how to solve these problems and the acceptance of responsibility for the solution of the problems as a basic civic duty. (p. 53)

Hungerford and Tomara (1977) emphasized the domain or component of action in their definition indicating that the goal of environmental education is "the development of an environmentally literate citizenry, i.e. a citizenry that is both competent to take action on critical environmental issues and willing to take that action" (In Roth, 1992, p. 20). Volk, Hungerford, and Tomara (1984) expanded this statement by stating "Environmental education is failing in its endeavor to develop knowledgeable, concerned, competent and participating citizens, i.e., environmentally literate human beings" (p. 17).

Several additional definitions were published in the 1980s. Roth (1984) said the task of environmental education was to produce citizens who:

a. Understand the self-regulating systems of our life sustaining planet;
b. Operate their lifestyles in congruence with those self-regulating systems; and
c. Work cooperatively to eliminate cultural activities that significantly disrupt the life-sustaining systems. Such citizens are considered to be environmentally literate. (p. 46)

Rockcastle (1989) provided a rather detailed definition and description of environmental literacy:

> Environmental literacy is an understanding, at some basic level, of the interaction of humans and their natural environment with regard to both living things and non-living things (air, water, soil, and rocks). The interaction implies taking from as well as putting into. It includes what humans do with, to, and for plant and animal life, as well as what plant and animal life does in response to human intervention. There is hardly a human activity that leaves no consequence to both the biota and Earth's mantle. The interaction includes short- and long-term subtleties as well as gross and obvious causes and results. Environmental literacy is an awareness and understanding of the basic relationships in the interaction. (p. 8)

In 1989, UNESCO-UNEP announced that 1990 would be the United Nation's year of International Literacy. In their newsletter *Connect* they offered another conceptualization of environmental literacy:

> *Environmental literacy for all*, that is, a basic functional education for all people, which provides them with the elementary knowledge, skills and motives to cope with environmental needs and contribute to sustainable development. In other words, environmental literacy is conceived as *functional* literacy in the same sense that function – problem-solving, community participation – is considered

> the operating principle of environmental education. Similarly, the environmental movement itself, in becoming one of the most important of our time, is demonstrating its maturity by reaching out for political and practical responsibilities in the preservation and improvement of the environment, that is, the quality of life. (p. 1)

Erdogan, Kostova, and Marcinkowski (2009) provided a definition of environmental literacy as "basic functional education for all people which provides them with the elementary knowledge, skills and motives to cope with environmental needs and contribute to sustainable development" (p. 16). The Programme for International Student Assessment (PISA), which has conducted literacy assessments in over 70 countries, defined literacy as "the capacity of students to apply knowledge and skills in key subject areas and to analyze, reason, and communicate effectively as they pose, solve, and interpret problems in a variety of situations" (OECD, 2010 in Hollweg et al., 2011, p. 2-1).

Gilbertson (1990) defined environmental literacy as "the knowledge and attitude one has which enables that individual to behave in a responsible manner toward the environment" (p. 20). Perhaps one of the most significant advances in the definition of environmental literacy was that of Marcinkowski (1990) who used a review of research literature through the years to provide a comprehensive list of what environmental literacy involves, modifying the Tbilisi document as follows:

Environmental literacy involves:

a. An awareness and sensitivity toward the environment.
b. An attitude of respect for the natural environment, and of concern for the nature and magnitude of human impacts on it.
c. A knowledge and understanding of how natural systems work as well as how social systems interface with natural systems.

d. An understanding of the various environmentally related problems and issues (local, regional, national, international, and global).
e. The skills required to analyze, synthesize, and evaluate information about environmental problems/issues using primary and secondary sources, and to evaluate a select problem/issue on the basis of evidence and personal values.
f. A sense of personal investment in, responsibility for, motivation to work individually and collectively toward the resolution of environmental problems/issues.
g. A knowledge of strategies available for use in remediating environmental problems/issues.
h. The skills required to develop, implement and evaluate single strategies and composite plans for remediating environmental problems/issues.
i. Active involvement at all levels in working toward the resolution of environmental problems/issues. (Roth, 1992, pp. 23-24)

While there is clearly no single definition of environmental literacy, it has been used as a slogan of sorts. UNESCO-UNEP (1989) wrote the phrase "environmental literacy for all" much in the same vein as *The Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) used the phrase "science literacy for all." Both concepts were also touted as the primary goal of their respective disciplines.

The short-term goal of environmental education is responsible behavior/stewardship of the environment while the ultimate or long-term goal is the creation of an environmentally literate citizenry (Willis, 1999). Environmental literacy is built on an ecological paradigm (Roth, 1992). While environmental education draws its strength from predecessor fields such as conservation education, nature education, outdoor education, and science education, it derives its focus from the following four ideas:

1. The interrelationships between natural and social systems
2. The unity of humankind with nature
3. Technology and the making of choices
4. Developmental learning throughout the human life cycle. (Roth, 1992, pp. 16-17)

Among other characteristics, environmental literacy involves people in seeking connections between objects and events, evaluating the consequences of potential actions, and acting responsibly as one form of living thing among many diverse, interacting, and interrelated forms (Roth, 1992). Environmentally literate persons have knowledge of issues, action strategies, and a sense of responsibility (Hungerford, Peyton, & Wilke, 1981). The various definitions written for environmental literacy and the characteristics specific to an environmentally literate individual helped researchers develop domains or constructs of environmental literacy.

Domains of Environmental Literacy

Environmental literacy is based on the premise that a knowledgeable, skilled, and active citizenry is key to resolving current environmental problems and preventing future ones (Johnson & Mappin, 2005). According to the framework for environmental literacy developed by the NAAEE National Project for Excellence in Environmental Education (Hollweg et al., 2011), seven categories make up one's environmental literacy. These include:

- **Affect** – factors within individuals that allow them to reflect on environmental problems and issues at an intrapersonal level and to act on them if they judge the problem/issue warrants action;
- **Ecological Knowledge** – knowledge of major ecological concepts; knowledge and understanding of how natural systems work and how they interface with social systems;
- **Socio-political Knowledge** – understanding of the relationships between beliefs, political systems, and environmental values of various cultures; understanding of how human cultural activities (religious, economic, political and social) influence the environment from an ecological perspective; knowledge related to citizen participation in issue resolution;
- **Knowledge of Environmental Issues** – understanding of environmental problems and issues caused as a result of human interaction with the environment; knowledge related to alternative solutions to issues;
- **Cognitive Skills** – abilities to analyze, synthesize, and evaluate information about environmental problems/issues on the basis of empirical evidence and personal values; abilities to select appropriate action strategies and to create, evaluate, and implement action plans;
- **Additional Determinants of Environmentally Responsible Behavior** – locus of control and assumption of personal responsibility; and
- **Environmentally Responsible Behavior** – active and meaningful participation in solving problems and resolving issues; Categories for environmentally

> responsible action include persuasion, consumer action, eco-management, political action, and legal action. (Adapted from Simmons, 1995, pp. 55-58)

As the definitions for and characteristics of environmental literacy have developed through the years, several of these categories have been combined to create four interrelated domains or constructs: knowledge, affect, cognitive skills, and environmentally responsible behavior (Cook & Berrenberg, 1981; Hungerford & Volk, 1990; Stern, 2000). According to Hollweg et al. (2011), behavior is the ultimate expression of environmental literacy. Development of environmental literacy occurs on a continuum and is facilitated by reflection, further learning, and additional experiences.

As suggested by Hollweg et al. (2011), environmental literacy is not binary in nature; one is not either literate or illiterate. Roth (1992) stated the degree of literacy is best measured by observing behavior. People should be able to demonstrate, in some observable form, what they have learned – their knowledge of key concepts, cognitive skills, and affect or disposition toward issues and problems. As with scientific literacy, or any other literacy for that matter, varying degrees of proficiency can be observed along the continuum from lack of competency to high level competency. Roth described three levels of environmental literacy:

> **Nominal environmental literacy** – indicates a person is able to recognize many of the basic terms used in communicating about the environment and is able to provide rough, if unsophisticated, working definitions of their meanings. Persons at the nominal level are developing an awareness and sensitivity towards the environment along with an attitude of respect for natural systems and concern for the nature and magnitude of human impacts on them. They also have a rudimentary knowledge of how natural systems work and how human social systems interact with them.

Functional environmental literacy – indicates a person with a broader knowledge and understanding of the nature of and interactions between human social systems and other natural systems. They are aware and concerned about the negative interactions between these systems in terms of at least one or more issues and have developed the skills to analyze, synthesize, and evaluate information about them by using primary and secondary sources. They evaluate a selected problem/issue on the basis of sound evidence and personal values and ethics. They communicate their findings and feelings to others. On issues of particular concern to them, they evidence a personal investment and motivation to work toward remediation using their knowledge of basic strategies for initiating and implementing social or technological change.

Operational environmental literacy – indicates a person who has moved beyond functional literacy in both the breadth and the depth of understandings and skills who routinely evaluates the impacts and consequences of actions; gathering and synthesizing pertinent information, choosing among alternatives, and advocating action positions and taking action that work to sustain or enhance a healthy environment. Such people demonstrate a strong ongoing sense of investment in and responsibility for preventing or remediating environmental degradation both personally and collectively, and are likely to be acting at several levels from local to global in so doing. The characteristic habits of mind of the environmental literacy are well ingrained. They are routinely engaged in dealing with the world at large. (p. 6)

Each level of environmental literacy is subject to additional stages through which individuals can progress. Within each stage there are components of awareness, concern, understanding and action. Operational environmental literacy, much like true scientific literacy, is difficult to achieve yet is the ultimate goal of environmental education. One can be operationally environmentally literate only when all of the components come together in the observable actions taken by the individual. Through the complete integration of each of the four domains, an individual exhibits the highest level of environmental literacy.

Current Issues and Trends in Environmental Education

Iozzi (1988) discussed the varieties of environmental education programs currently found in the U. S. and throughout the world. Contrary to Carter and Simmons (2010), environmental education does not have to be taught as a discrete discipline. A key characteristic of environmental education is that it extends beyond the scope of conventional curriculum or even classroom boundaries (Larkin, 1977). As a result, environmental education lacks a formal niche within the K-12 curricula in many states and is often ignored. Several researchers have conducted content analysis studies of textbooks to determine the extent to which environmental education content was included in the most commonly used textbooks (Gibson, 1996; McComas, 2003; Wilson, 2000). Wilson and McComas each found the level of inclusion of environmental content in the typical high school biology textbooks was approximately 10%. McComas (2003) also noted the importance of environmental education in reinforcing and tying scientific principles together in the minds of the students. In addition to uniting biological sciences, McComas believed environmental education provides controversy. Controversy results in two contrasting aspects of environmental education. McComas identified the first as “concept” orientation in which students are taught the scientific principles governing the environment. The second orientation is focused on “action.” Students are encouraged to become involved in environmental activism.

The two contrasting views of environmental education are also discussed by Disinger (1983 & 2001). Clearly, people have competing agendas associated with diverse environmental worldviews as well as contrasting perspectives of what environmental education is and should be. Since teachers are human, suggested Disinger, with personal worldviews, opinions, and causes that they support. One criticism of environmental education is that it is biased toward pro-environmental positions. Tensions exist among educators because environmental education is interdisciplinary in nature and not supported by most school organizational patterns or teacher certification programs. Some aspects of environmental education fit into existing science curricula, some in social studies, and others in mathematics; yet the subjects are not coordinated with one another in most school structures. Recently, however, a movement has been seen in some school districts toward cross-disciplinary and interdisciplinary courses (block scheduling for example). A curricular organization that focuses efforts on cross-disciplinary and/or interdisciplinary instruction lends itself easily to the use of overarching themes such as environmental science.

Pursuing Environmental Literacy through Environmental Education

Incorporating environmental education into the schools from pre-K through post-secondary is vital to producing a citizenry that is environmentally literate, engaged in responsible environmental behavior, and adept at critical thinking and problem solving skills. Environmental literacy requires skills and knowledge from the sciences, social sciences, and humanities. Therefore, environmental education should be approached from a holistic perspective rather than as a discrete, isolated discipline. The primary goals of environmental education are to develop environmentally literate citizens and to promote responsible environmental behavior (Culen, 2005). Therefore, environmental education is essential to general education as well as to environmental literacy.

If citizens are to address existing environmental problems and prevent new ones, they need to be environmentally literate and capable of making well-informed public policy decisions collectively. As world population grows, technology advances, and competition increases for resources to maintain quality of life, all individuals will have to make difficult and complex decisions that affect their own lives, the lives of their families, their communities and the world. Environmental education must play a vital role in educating citizens to have the knowledge, skills, and abilities to make those informed decisions.

In 1987, the tenth anniversary of the Tbilisi conference, a "Tbilisi Plus Ten" conference was held in Moscow. One of the major themes that emerged from the conference was the importance of environmental education in developing environmental literacy. The following is an excerpt from the opening address:

> In the long run nothing significant will happen to reduce local and international threats to the environment unless widespread public awareness is aroused concerning the essential links between environmental quality and the continued satisfaction of human needs. Human action depends upon motivation, which depends upon widespread understanding. This is why we feel it is so important that everyone becomes environmentally conscious through proper environmental education. (UNESCO, 1987)

Simmons (2005) pointed out that environmental education can be used to meet discipline-based standards. Because of its interdisciplinary nature, environmental education can help students meet high standards in science, math, English and social studies. In addition, environmental education can be integrated throughout the curriculum where it has the potential to further environmental education reform (Conley, 1993). As Disinger (1993) pointed out, environmental education can facilitate learning of concepts and process skills, but it also provides the opportunity for synthesizing information and material that crosses disciplinary boundaries, making learning more holistic and relevant for the student. He stated:

> An implicit assumption of disciplinary philosophies is that students will be able to perform their own synthesis when it becomes necessary to do so, by drawing as needed on their learnings from separate content areas. But rarely do students receive instruction or engage in guided practice in developing syntheses and drawing generalizations…Environmental education can provide a convenient and challenging mechanism for overcoming the shortcomings of monodisciplinary education, by using the interdisciplinary entity that is the environment as a focus for teaching and learning. (Disinger, 1993, pp. 40-41)

"Well-constructed environmental education programs are learner-centered, providing students with opportunities to construct their own knowledge through hands-on, mind-on investigations." (National Environmental Education Advisory Council, 2001, p. A-5) Learning theories such as inquiry-based learning, place-based learning, project-based learning, and experiential learning are effective pedagogical strategies for developing critical thinking and problem solving skills necessary to solve complex environmental problems. Environmental education promotes systems thinking. Student-centered studies of the environment provide real world contexts and authentic problems/issues from which concepts and skills can be learned. Because environmental education is systems driven, it provides a unique opportunity to link PreK-12 curriculum by creating a comprehensive and cohesive program across the curriculum.

Students need a comprehensive program that covers the range of knowledge, skills, affect, and behavior that are essential to fostering environmental literacy (Simmons, 2005). Numerous studies have been conducted to assess the effectiveness of educational programs on influencing components of environmental literacy. Volk and McBeth (1997) compiled studies previously conducted to determine if environmental literacy components were positively influenced through instruction. The majority of the studies measured attitude (74%), followed by issue knowledge (37%), responsible environmental behavior (24%), and ecological knowledge (18%). The most effective instruction was community investigation and citizenship participation. Also effective were environmental studies/management courses.

Other studies have been conducted to evaluate what combinations of formal, informal, and other environmental experiences for youth have contributed to the development of environmental literacy (Hollweg et al., 2011). Iozzi (1984), Rickinson (2001), and Volk and McBeth (1997) found environmental education programs contributed positively to increases in student knowledge and shifts in attitude. Few programs, however, have contributed significantly to the development, application, and transfer of cognitive skills. Environmental action research, environmental issue and action instruction, and environmental service learning instructional approaches have shown to contribute to the abilities of students to participate in environmental decision making and problem solving (Coyle, 2005; Marcinkowski, 2004; Rickinson, 2001; Volk & McBeth, 1997).

Promoting environmental education in early childhood takes advantage of the natural curiosity of young children. Teachers can use this curiosity to develop inquisitiveness in children about the natural world (Chalufour & Worth, 2003). Wilson (1999) created guidelines for developing and implementing an environmental education program in early childhood classrooms based on how children learn. The following guidelines were adapted from Plevyak and Mayfield (2010):

- Begin with simple experiences.
- Keep children actively involved.
- Provide pleasant, memorable experiences.
- Emphasize experience versus teaching.
- Involve full use of senses.

- Provide multimodal (learning in different ways) learning experiences.
- Focus on relationships.
- Demonstrate a personal interest in and enjoyment of the natural world, and model caring for the natural environment.
- Maintain a warm, accepting, and nurturing atmosphere.
- Introduce multicultural experiences and perspectives.
- Focus on the beauty and wonder of nature.
- Go outside whenever possible.
- Infuse environmental education into all aspects of an early childhood program. (p. 53)

Using supplemental educational materials, like *Project Learning Tree* (2006), *Project WET* (2010), and *Project WILD* (2000), helps integrate multiple subject areas so they can be used in theme-based lessons or traditional formal classrooms. Research has found that using the environment to integrate learning in other content areas is the most effective way to teach environmental education (Lieberman & Hoody, 1998). Learning about the environment involves "knowledge and skills from all disciplines" (Grant & Littlejohn, 2005, p. xi).

The literature demonstrates how environmental education within the school curriculum is effective at increasing certain components of environmental literacy. Wilson (1999) outlined the importance of starting this environmental education early in schooling, within the early childhood classroom. According to Roth (1992), schools have a significant influence on the cognitive and knowledge domains of environmental literacy. A comprehensive and cohesive curriculum which builds from year to year is necessary to produce students who are environmentally literate and capable of actively participating as adults in the communication required of a democratic society. Students learn a great deal from their parents, either by direct instruction or by modeling behavior. Roth (1992) described the other ways in which one learns about the environment. The community provides significant influence on students, particularly in developing the affective domain. The media and interest groups play a role in influencing a mixture of awareness, affective, and cognitive domains. According to Roth (1992), environmental education affects learners from ages 5 or 6 to 17 or 18 (through secondary school) and possibly into the 20s if one attends post-secondary education. The other influences continue throughout a lifetime, promoting lifelong learning and the continued pursuit of environmental literacy. The foundational understandings and cognitive skills developed during formal schooling are essential to evaluating and moderating the information one receives throughout life.

Arkansas Curriculum Frameworks and Environmental Education

The Arkansas Department of Education K-8 science curriculum framework does not specifically address environmental education. However, within the Life Science Strand, many environmental concepts are listed including the following:

- Students shall demonstrate and apply knowledge of living systems using appropriate safety procedures, equipment and technology;
- Students shall demonstrate and apply knowledge of life cycles, reproduction, and heredity using appropriate safety procedures, equipment and technology; and
- Students shall demonstrate and apply knowledge of populations and ecosystems using appropriate safety, procedures, equipment, and technology.

The Earth Science Strand includes components of environmental education as well. Specifically, the strand states “students shall demonstrate and apply knowledge of Earth’s structure and properties using appropriate safety procedures, equipment, and technology" (p. 40). Additionally, "students shall demonstrate and apply knowledge of Earth's history using appropriate safety procedures, equipment, and technology (p. 46). Finally, "students shall demonstrate and apply knowledge of objects in the universe using appropriate safety procedure, equipment, and technology" (p. 47).

In the Arkansas K-4 frameworks, the students learn about classifying living systems including living versus non-living in kindergarten to classifying vertebrates and invertebrates in 4th grade. Grades 1 and 2 locate plant parts and describe the functions of key parts. In kindergarten, students learn what it means for a species to be extinct; 1st grade learns to identify endangered species in Arkansas; 2nd grade compares and contrasts living and extinct species and describes the characteristics of habitats; and 4th grade recognizes environmental adaptations of plants and animals and learns to evaluate the interdependence of organisms in an ecosystem. Strand 4 which includes earth and space science includes learning about the major landforms on the earth, identifying the components and properties of soil and its role in plant growth. Fourth grade students learn to locate natural divisions of Arkansas (ESS.8.4.1). The K-4 frameworks also include goals regarding natural resources, including evaluating the impact of Arkansas' natural resources on the economy, including farming, timber, tourism, hunting, and fishing (ESS.8.4.4). These are a few of the many examples within the Arkansas Science Curriculum Frameworks (Arkansas Department of Education, 2005a) where science standards are interrelated with environmental education concepts.

Fifth grade students delve into the more explicit environmental concepts. They learn to distinguish among and model organisms, populations, communities, ecosystems, and the biosphere. They explore energy pyramids, food webs for specific habitats, and flow of energy within communities, both terrestrial and aquatic. Students become aware of the concepts of carrying capacity and limiting factors as well as categorizing organisms by the function they serve in ecosystems and food webs.

Sixth grade students continue, to a lesser degree, to study environmental factors that can affect the survival of individual organisms and ecosystem as a whole. They also explore structural and behavioral adaptations for survival in the environment and differentiate between innate and learned behaviors. Both 5th and 6th grade standards also include earth and space science strands with concepts of landforms, nature of ancient environments based on fossil records, soil formation, sedimentation, erosion, and modeling geological events. Each of these is also interconnected with environmental concepts.

The curricula for Arkansas' Environmental Science Course for secondary students can be found on the Arkansas Department of Education Website (2005). This course, designed for grades 9-12, is not required for graduation in Arkansas. According to the Arkansas Department of Education (ADE), the purpose of the course is to do the following:

> Environmental science should examine the physical and biological dynamics of Earth. Students should analyze the impact of human activities on the environment. Field studies, as well as the process of collecting and analyzing data, should be an integral part of the course. Instruction and assessment should include both appropriate technology and the safe use of laboratory equipment. Students should be engaged in hands-on laboratory experiences at least 20% of the instructional time. (ADE, 2005b, p. 1)

Research-Based Assessments of Environmental Literacy

Education leaders, policy makers, researchers and educators in many countries have identified the need for research and data collection on the status of environmental literacy (Hollweg et al., 2011). Assessments of environmental literacy are a great source of information, but such assessments are relatively new. Early assessments focused on students' environmental knowledge and attitudes (Cortes, 1987; Kuhlmeier, Van Den Bergh, & Lagerweij, 2005; Makki, Abd-El-Khalick, & Boujaoude, 2003; Marcinkowski et al., 2011). In the U.S., two assessments were developed to evaluate the knowledge, skills, affective, and behavioral domains of environmental literacy. These included the Middle School Environmental Literacy Survey (MSELS) and the Secondary School Environmental Literacy Instrument (SSELI) (Hungerford et al., 2009 & Wilke, 1995). Researchers in Korea (Shin et al., 2005) and Israel (Negev et al., 2008) have developed national assessments for their respective countries that use similar domains for measurement of environmental literacy. These assessments have been favorably compared to the U.S. assessments (Marcinkowski et al., 2011).

In 2008 the *National Environmental Literacy Assessment Project: Year 1, National Baseline Study of Middle Grades Students* final research report was published (McBeth et al., 2008). The study was designed to provide a national measure of environmental literacy and to develop a comprehensive, research-based instrument that could be used by others so that comparisons can be made to the national assessment data. The result was to assess the current state of environmental literacy in the U.S. so as to develop better, more formalized, educational curricula.

Stevenson et al. (2013) examined the impact of school-wide environmental education programs among middle school students in North Carolina on environmental literacy using the MSELS instrument developed by Hungerford et al. (2009). Findings suggested that using environmental education and time outdoors in tandem helped foster all four components of environmental literacy. Published environmental education curricula such as Project WILD, Project WET, and Project Learning Tree were effective at building cognitive skills (Stevenson et al., 2013).

Summary

The literature reviewed in this chapter lays the foundation for this study. The historical foundations for environmental education are well established. These foundational principles were used to construct domains of environmental literacy, constructs that are essential if we, as a society, are to solve the complex environmental problems today and in the future. Student assessment of environmental literacy is vital to the development of environmental literacy planning and environmental education curricula development. Though a national assessment was completed during the 2006-2007 school year, no large-scale assessments have been conducted on a statewide basis to establish a baseline to which future assessments can be compared. This study builds upon the preceding research efforts by assessing the environmental literacy of 6^{th} grade students across Arkansas, establishing that baseline to which future Arkansas assessments can be made. Additionally, the new data obtained in the Arkansas study can be compared to the national baseline previously established.

Chapter III Methodology

Introduction

The purpose of this ex post facto, state of affairs study was to assess the environmental literacy of 6th grade students across Arkansas. The Middle School Environmental Literacy Survey (MSELS) was administered to 3,446 sixth grade Arkansas students to establish baseline information on the environmental literacy of the Arkansas students, to compare the Arkansas environmental literacy results to those obtained during the nationwide assessment, and to evaluate the present use of environmental education curricula in Arkansas schools.

Research Questions

Research Question 1*:* What is the level of environmental literacy of sixth grade students across Arkansas on the following constructs included in the MSELS and how do these findings compare to the national baseline data:

a) Ecological knowledge;
b) Verbal commitment;
c) Actual commitment;
d) Environmental sensitivity;
e) General environmental feelings;
f) Environmental issue identification;
g) Issue analysis; and
h) Action skills.

Research Question 2*:* What are the composite levels of environmental literacy of 6th grade students across Arkansas and how do these findings compare to the national baseline data?

Research Question 3: To what degree does the environmental literacy of students across Arkansas differ and/or correlate based on the following school-level demographic information:

a) Physiographic and geographic regions of state;
b) Sixth grade total enrollment (fewer than 50 students, 50-100 students, and more than 100 students);
c) Socio-economic status (based on total percentage free and reduced lunch);
d) Locale;
e) School organization (elementary versus middle, teacher organization, and curriculum organization); and
f) Science and literacy benchmark test scores.

Research Question 4: To what degree do the levels of Arkansas students' environmental literacy differ based on teachers' self-reported demographics, use of environmental education curriculum and pedagogical strategies?

Research Question 5: To what degree is there a correlation between environmental literacy and the students' self-reported level of engagement in outdoor activities? Further, to what degree does the availability of an outdoor classroom and/or community garden on school grounds and the teachers' reported usage of that space impact the students' environmental literacy?

Research Question 6: What are the differences and similarities assessed by the survey between the three highest performing schools and the three lowest performing schools on this environmental literacy survey?

This study was designed as a type of survey research with an overarching purpose to describe the environmental literacy characteristics of 6th grade students in Arkansas. Three surveys were used in this study and will be discussed under Instrumentation later in this chapter.

Written permission to use the MSELS instrument was obtained from Dr. Trudi Volk, Center for Instruction, Staff Development & Evaluation in Carbondale, Illinois (Appendix A).

Research Ethics

The University of Arkansas Institutional Review Board approved this study (IRB # 13-13-575) (Appendix A). School principals signed a letter of engagement to provide their written intention to participate fully in the study. Teachers participating in the study also provided written consent. Students and their parents/guardians were given a Passive Consent Form. The form was only signed and returned if the parents did not want their student to participate. Only 23 parents returned the Passive Consent Form to exclude their students from participating in the research project.

Research Setting and Participants

The target population for this study was sixth grade students in Arkansas. The sampling frame included all public schools in Arkansas with 6th grade students. From this group 40 schools were randomly selected. The sample consisted of 6th grade students who obtained parental consent to participate in the study from the stratified, randomly selected schools that agreed to participate in the study. Based on the number of independent variables proposed for the study, we proposed sampling approximately 10% of the target population. Data published for the 2011-2012 school year indicated there were approximately 37,000 students in public schools statewide attending sixth grade. These numbers were used as the basis for the sample selection. The sampling fraction was established at approximately 3,700 students. The researcher selected students proportionally stratified from schools based on based on 6th grade enrollment and geographically by zip code. In order to select the sample, a clustered systematic random selection was used. A 2-step cluster was used with schools clustered by 6th grade enrollment and zip code. Clustering by 6th grade enrollment helped ensure that students representative of the entire Arkansas sixth grade population were chosen for the study. Table 3.1 depicts the general sixth grade population based on 6th grade enrollment numbers as reported by the Arkansas Department of Education and the final sampling population based on the clustered systematic random selection and schools who agreed to participate in the study. The 6th grade sizes were categorized as small (fewer than 50 6th grade students), medium (50-100 6th grade students), and large (more than 100 6th grade students). After clustering all 267 public schools with sixth grade students and calculating the cumulative number of students from 1 through 3,700, a random number generator was used to select the first student number. The school from which the student was selected was then included in the list of selected schools. Once the school was identified, the entire 6th grade was included in the study. The sampling fraction was then added to the random number and the next student was identified. This iterative process continued until the desired number of participants was identified. The selection resulted in 40 schools and 4,309 potential students. In terms of 6th grade size, the sampling population was similar to the general population. However, the sample student population was higher for the middle sizes (schools with 51-100 6th grade students) and lower for the larger (more than 100 6th grade students) than the general student population (Table 3.1). Several factors led to this disparity. First, some students were absent on the days when researchers administered the survey resulting in a student population different than planned. At one school, a mix-up in scheduling resulted in surveying only 78 of the 336 students enrolled in the 6th grade. This was a large school (more than 100 6th grade students). Another school had a band concert for the lower grades scheduled at the same time so that only 102 out of 145 students were surveyed. Finally, a large school (391 students) from northwest Arkansas cancelled their participation prior to data collection. A replacement school of equal size and within the same geographic area could not be found in time to participate. Student absenteeism and school scheduling conflicts were beyond the control of the researcher in this case.

Table 3.1

Sample Population Comparison with General Population of Sixth Graders

	General Student Population		Sample Student Population	
6th Grade Size (# Students)	# Students	Percent of Total	# Students	Percent of Total
0-50	4,304	11.8	344	10.0
51-100	7,459	20.4	1203	34.9
≥ 101	24,829	67.8	2157	55.1

Additionally, the geographic stratification was effective by using the stratified random selection technique. Schools randomly selected provided good areal coverage as represented by the dots in Figure 3.1. The background of the map has been purposefully blurred so that the confidentiality of the participating schools could be protected.

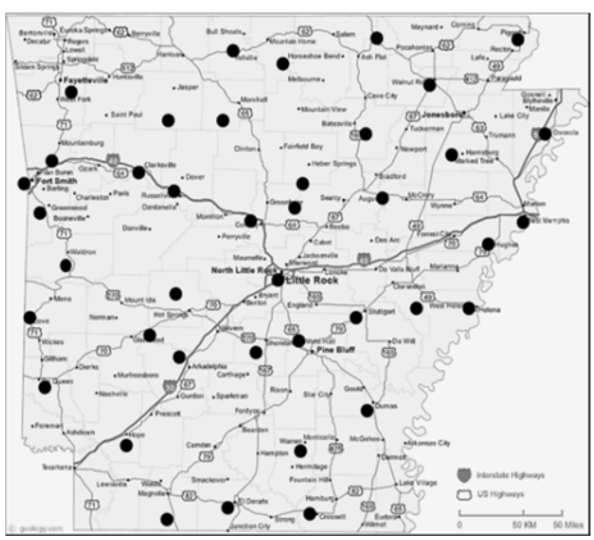


Figure 3.1. Geographic Locations of Participating Schools

Instrumentation

Three survey instruments were used in this study. All were originally designed for the national baseline study (McBeth et al., 2008). The Middle School Environmental Literacy Survey (MSELS) was used without revision (Appendix B). Three-thousand five hundred copies of the survey booklet were provided by Dr. Trudi Volk, Executive Director of the Center for Instruction, Staff Development & Evaluation, located in Carbondale, Illinois.

The other two surveys were adapted from those used for the national study but were tailored to gather information specific to the research questions of this environmental literacy study. Permission to revise the forms for use in this study was granted by Dr. Volk. The Environmental Program Information Form (Appendix C) was designed to gather information about the participating schools including instructional/program practices and the environmental programs in the schools and classrooms. The Environmental Program Information Form was completed by a person selected by the school principal as being the most knowledgeable about the curricular programs school-wide. The third instrument, Teacher Information Form and Survey (Appendix C), was designed to gather information about participating teachers including teacher demographics, teaching settings used throughout the school year, teaching strategies in the classroom, types of student assessments used, and personal views on the environment and environmental education. These data were used to provide a more complete description of the sample as well as allow for interpretation of student environmental literacy results as a function of teacher and school attributes.

Environmental Program Information Form. This form was used to gather information about the curricular and instructional program practices and types of environmental programs at each of the participating schools. McBeth et al. (2008) used the form in the original National

Environmental Literacy Assessment project (NELA) to characterize the types and prevalence of environment education and science programs used in the participating schools. The survey also explores the major educational goals and objectives for the 6th grade students, the curriculum organization (intra- versus inter-disciplinary instruction), and the organization of the teachers in the 6th grade classes. Questions were also included to determine if the schools have outdoor classrooms or community gardens and the extent to which each is used.

Teacher Information Form and Survey. The Teacher Information Form and Survey was designed to collect demographic data on participating teachers as well as to provide insight into teachers' views of the environment and environmental education. For the purposes of this study, the form was modified to also provide information about pedagogical strategies used in the classroom, including use of hands-on instruction, inquiry-based instruction, outdoor educational opportunities, and other creative efforts in teaching. Additional Likert-style questions were included to gauge attitudes about the environment and environmental education. These data provided attributes of the teachers that helped explain differences in environmental literacy scores between classrooms and schools.

The Middle School Environmental Literacy Survey (MSELS). The existing MSELS instrument was used to assess the environmental literacy of the sixth grade students throughout Arkansas. Developed and modified through several years of research and evaluation, the instrument was developed by researchers for collecting data for the NELA (Hungerford et al., 2009). An overview of the MSELS content is presented in Table 3.2. The four domains or general conceptual variables of environmental literacy were, in some cases, expanded to include multiple specific conceptual variables. The survey consists of 75 items. Part I was designed to collect demographic data about the students and was not scored. Two of the questions, gender and ethnicity, were used as independent variables when analyzing the data. Part II of the survey, Ecological Foundations, consists of multiple choice responses with four possible responses per question. Parts III, IV, V, and VI are structured as 5-point Likert scale responses. Parts VII.A

Table 3.2.

Overview of the "Middle School Environmental Literacy Survey"

Components of Environmental Literacy (General Conceptual Variables)	**Specific Conceptual Variables**	**Parts of the *MSELS****	**Item Number**	**N Items**	**Poss. Pts.**
A. Ecological Knowledge	Ecological Knowledge	Part II: Ecological Foundations	5 – 21	17	17
B. Environmental Affects	Verbal Commitment (Intention)	Part III: How You Think About the Environment	22 – 33	12	60
	Environmental Sensitivity	Part V: You and Environmental Sensitivity	46 – 56	11	55
	Environmental Feeling	Part VI: How You Feel About the Environment	57, 58	2	10
C. Cognitive Skills	Issue Identification	Part VII.A: Issue Identification	59, 60, 67	3	29
	Issue Analysis	Part VII.B: Issue Analysis	61 – 66	6	
	Action Planning	Part VII.C: Action Planning	68 - 75	10	
D. Behavior	Actual Commitment (Pro-Environmental Behavior)	Part IV: What You Do About the Environment	34 – 45	12	60
	Demographics	Part I: About Yourself	1 – 4	4	NA

* Parts II – VII are scales that measure environmental literacy variables; Part I was included on the *MSELS* to collect demographic information about the students.

and VII.B consist of reading a passage and selecting the best answer to questions posed with five possible responses (Items 59-67). Correct answers were scored. Part VII.C (Items 68-75) represents possible action strategies to an environmentally related scenario and asks the student to pick the two best action strategies from the list of eight. Responses were scored based on the appropriateness of the answers as provided in the scoring protocol.

The researchers conducted factor analyses for the scales of the MSELS. A one-factor model for each scale was a best fit, confirming that each scale is, in fact, uni-dimensional. Each scale measured the one conceptual variable it was designed to measure. Thus, each scale reportedly is a valid measure of that variable for the 6th grade population.

Cronbach's Alpha Coefficient was used to determine reliability of the instrument during the national baseline study and the Arkansas study. The values are shown in Table 3.3 for each of the measured constructs by study. All constructs measured had Chronbach's alpha values above 0.70, indicating a high level of reliability in the constructs.

Table 3.3.

Cronbach's Alpha Values Reported for the Measured Constructs of the MSELS

Construct Measured	Cronbach's Alpha National Study	Cronbach's Alpha Arkansas Study
Part II. Ecological Knowledge	0.717	0.734
Part III. Verbal Commitment	0.847	0.807
Part IV. Actual Commitment	0.781	0.745
Part V. Environmental Sensitivity	0.749	0.703
Parts V and VI. Environmental Sensitivity and Environmental Feeling (combined)	0.778	0.707

Source for National Study: McBeth et al., 2008

The final test of the MSELS instrument was the determination of its readability using the Flesch Reading Ease and Grade Level Indexes. The Flesch Reading Ease score for the instrument was 66.4, indicating a standard reading ease. The Grade Level Index correlated the reading ease to 6th and 7th grades (McBeth et al., 2008).

Data Collection

On December 15, 2012, the researcher sent a letter to the principals at the randomly selected schools. The letter identified the purpose of the study, provided some background information, and asked the principal to complete a Letter of Engagement (Appendix C-1) if he/she was willing to participate in the study. By the end of January 2013, a number of the schools had either refused to participate or had not responded to the request. Follow-up letters were then sent to the principals based on the previously randomized list again requesting their participation in the environmental literacy project for Arkansas. These correspondences failed to identify enough schools to participate. A mailing then was sent to the principals at all Arkansas public schools with 6th grade students containing the information originally presented to the principals and requesting participation. As principals responded positively to participating, those schools were identified on the randomized list. To conform to the stratified random protocol as closely as possible, the agreeing school closest on the list to the originally selected school was chosen for participation. Letters of Engagement were obtained from each participating school to ensure full participation. Once all schools were selected, the development of the forms was completed. The Environmental Program Information Form (Appendix C-2) and the Teacher Information Form and Survey (Appendix C-3) were generated. The Teacher Informed Consent Form (Appendix C-4) was also developed. A Passive Parental Consent Form (Appendix C-5) was developed to secure parental permission for the students to participate.

Each principal identified a contact person at the school who was most familiar with the environmental education and/or science instruction at the school. This person was asked to coordinate the completion of the Environmental Program Information Form and distribute the Teacher Information Form and Survey to all 6th grade science teachers at the school. The contact person was also responsible for approving the scheduling of the students' data collection and coordinating with the other teachers as appropriate. Thirty-nine of the 40 schools returned the Environmental Program Information Forms. Additionally, fifty-eight of the 60 participating science teachers returned the Teacher Information Form and Survey. The Letter of Engagement contained information as to the number of students to be surveyed, the number of class periods required to administer the survey to all of them, and the optimal dates for data collection. This information was used for scheduling purposes.

Most school principals wanted to have the students take the survey after benchmark testing. The optimal time was the end of April, 2013 (benchmark testing was scheduled statewide April 8 -12, 2013). Several principals requested data collection the week of April 22, 2013. Five individuals or groups of individuals were scheduled to assist in student data collection due to the short time frame for data collection, the geographic distribution of schools throughout the state, and to accommodate the desired scheduling of the principals. Table 3.4 shows those, by category, who administered the surveys to students, dates of data collection, and school codes for the dates.

Students were administered the MSELS beginning April 22, 2013 and ending May 20, 2013. Sampling at the end of the school year was requested by the researchers who developed the MSELS to capitalize on optimum student maturity and curricular impact. This was necessary in order to be able to make direct comparisons to the national baseline data. The student surveys were administered during regularly scheduled classes. Some school administrators chose to survey all students at once in the school cafeteria or auditorium. Others were administered in classrooms, often with multiple classrooms of students taking the survey at one time. The researchers were trained by the Principal Investigator prior to travelling to the schools for data collection. A protocol was read to the students by each of the researchers prior to administering the survey to ensure consistency in data collection across schools and classrooms. Students whose parents declined permission to participate were given an alternative activity at the discretion of the teacher(s). Twenty-three students in all were excluded from the study at the request of their parents. The student survey responses were recorded on a Scantron sheet provided by the researcher. Pencils were provided for students who did not have their own. Most students were given 50 to 60 minutes to complete the survey. In some cases, additional time was needed for completion. Some schools allowed for the additional time; others did not and the surveys were incomplete.

Table 3.4.

Scheduling of MSELS Data Collection by Week and Researcher(s)

Researcher(s)	4/22/13-4/26/13	4/29/13-5/3/13	5/6/13-5/10/13	5/13/13-5/17/13	5/20/13
Researcher 1	E*, I, II, H, HH	---	---	---	---
Research Group 2	G	---	J	---	---
Research Group 3	U, O, X, B, BB, Q	T, KK, K, FF	W, L, JJ	---	---
Researcher 4	S, AA, R, NN, CC	M, GG	Y, C, A	LL, F, Z	EE
Researcher 5	V	---	N, P, D, DD, MM	---	---

* School Codes

Data Entry, Formatting, and Editing

The Scantron sheets for each school were stored in individual file folders. A scoring protocol as used by the NELA researchers was provided by Dr. Trudi Volk. The Scanton forms were taken to the Academic/Research Support Division, Information Technology Services at the University of Arkansas, Fayetteville. A technician wrote a script for the scanner to read the Scantron forms into a text file. Forms were machine read and the resulting text file was provided to a computer programmer within the same department. The file was imported into MS Excel and checked for accuracy.

Following the protocol established by NELA, decisions were made when there was missing data. Large amounts of missing data would impact the calculations of scores and skew the results. If 25% or more of the possible responses in any section were not completed, the section was deemed unusable and all responses within the section were treated as missing values. The criteria as outlined in the NELA (McBeth et al., 2008) report can be found in Table 3.5. The exception was Part VII.C., in which students were to respond to only two action strategies. As long as one answer was provided, their response was deemed usable.

Table 3.5.

Criteria for Determining MSELS Section Scoring

MSELS Section	# Items	Criteria for Exclusion
II. Ecological Foundations	17	≥ 4 blanks
III. Intention to Act	12	≥ 3 blanks
IV. Service and Action	12	≥ 3 blanks
V. Sensitivity	11	≥ 3 blanks
VI. Attitudes or Emotional Connections	2	≥ 1 blank
VII.A. Issue Identification	3	≥ 1 blank
VII.B. Issue Analysis	6	≥ 2 blanks

The alpha data were converted to numeric data by the programmer. In addition, she used the scoring protocol provided and SAS 9.3 programming to convert the raw data into data formatted for statistical analysis. Data preparation included calculations of scores for each of the eight measured constructs of the MSELS, combined scores from the eight constructs into the four domains or general conceptual variables of environmental literacy, and computed adjusted scores to give each of the domains equal weights. These weighted scores were combined into the composite environmental literacy score.

Data Analysis

The School, Program, and Teacher Information Forms were entered into MS Excel spreadsheets. Information was analyzed by content analysis to generate frequency counts of pertinent information.

Research Question 1. What is the level of environmental literacy of sixth grade students across Arkansas on the key constructs included in the MSELS and how do these findings compare to the national baseline data?

Aggregated student scores for each scale were computed by SPSS 18. Descriptive statistics were calculated including sample size, mean, and standard deviation. These data were compared to the descriptive statistics reported in the national baseline study for the sixth grade cohort. An independent sample t test comparison was conducted on all measured constructs to determine whether the Arkansas data were significantly different from the national baseline data (population data). Frequency distributions were presented for the eight measured constructs. Item difficulty calculations were determined for those MSELS sections where correct responses were expected.

Research Question 2. What are the composite levels of environmental literacy of 6th grade students across Arkansas and how do these findings compare to the national baseline data?

The individual parts of the MSELS were combined into the four components or domains of environmental literacy. The combined component means were added to obtain an environmental literacy composite score for each student. An independent sample t test was onducted to determine if there were statistically significant differences between the national baseline composite scores and those of the Arkansas students.

Research Question 3: To what degree does the environmental literacy of Arkansas students' differ and/or correlate to the key demographic variables of interest.

Data were disaggregated to evaluate differences in levels of environmental literacy based on school attributes such as physiographic location within the state, school size, socio-economic status, locale, and school configuration. Benchmark literacy and science scores (averages reported for each school) were correlated to environmental literacy levels. Descriptive statistics were computed for each school as well as for each of the referenced school attributes. One-way ANOVA, between subjects design analyses were conducted to determine significant group differences within each of the school attributes.

Research Question 4: To what degree do the levels of Arkansas students' environmental literacy differ based on teachers' self-reported use of environmental education curriculum and pedagogical strategies?

Descriptive statistics for the environmental literacy domains and composite scores were calculated for each participating teacher including sample size, mean, and standard deviation. Frequency distributions and percentages were calculated for the demographic data including total teaching experience, gender, highest degree earned, age group, and ethnicity. The number of environmental courses attended and the number of environmental workshops/trainings were collapsed into three categories and five categories, respectively. Data regarding teaching/learning settings and teaching strategies/methods were summarized. One-way ANOVA with between subjects effects was used to determine if any of the teacher attributes were statistically significantly different between groups. Analysis of Variance was conducted on discrete variables such as years of teaching experience, highest degree earned, environmental education training, gender, and ethnicity. Pearson's product moment correlation was run on the teachers' self-reported sensitivity to the environment and the environmental literacy domains as well as composite scores. Correlations were also run based on the teachers' views of the importance of environmental education to students and the importance of environmental education to themselves.

Research Question 5. To what degree is there a correlation between environmental literacy and the students' self-reported level of engagement in outdoor activities? Further, to what degree does the availability of an outdoor classroom and/or community garden impact the students' environmental literacy?

Items 48 through 53 of the MSELS related directly to the students' level of engagement in outdoor activities. These items were Likert-type responses. Responses were summed over the six items to create a composite score for level of outdoor engagement. The range for the composite score was 6 to 30. Higher scores indicate a greater degree of contact with the outdoors. Data were collapsed into three categories – low (6-12), medium (13-22), and high (23-30). One-way ANOVA tests were conducted to see if significant differences existed between the groups. Student scores were disaggregated into two groups based on whether or not the school had an outdoor classroom/community garden. An independent t test was conducted to look for significant differences.

Research Question 6. What are the differences and similarities between the three schools scoring highest on the environmental literacy survey and the three schools scoring the lowest on the environmental literacy survey?

The three top performing schools (highest environmental literacy composite scores) and the three lowest performing schools (lowest environmental literacy composite scores) were analyzed with a matrix of school attributes, teacher attributes, and student attributes in an attempt to find similarities and differences across the schools to explain the gap in student scores. A similar process was followed to evaluate the teachers whose classes scored the highest versus those whose students scored the lowest. Such a comparison can inform researchers how to close the gap and improve the overall environmental literacy levels of students statewide.

Chapter IV Results

Introduction

This chapter presents the findings of the environmental literacy assessment of 6th grade students across Arkansas. A stratified random sampling scheme was used to identify 40 schools with nearly 4,000 students for the study. Quantitative data were collected from students through the use of the Middle School Environmental Literacy Survey (MSELS), from teachers through the use of the Teacher Information Form and Survey, and from schools using the Environmental Program Information Form. Using these data, the environmental literacy of 6th grade students was evaluated, through the use of descriptive and inferential statistics, identifying factors impacting environmental literacy and comparing the findings to those of a national baseline study of sixth grade students. Results were used to identify characteristics common to the top performing schools and compared those characteristics to those of the lower performing schools to identify characteristics of effective environmental education in Arkansas.

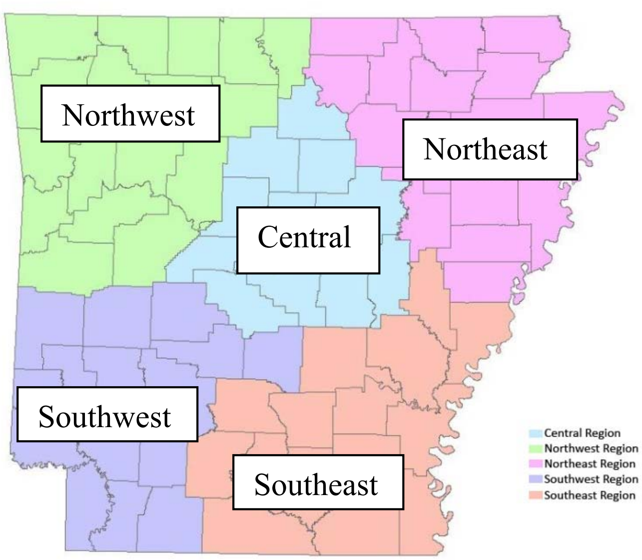
Population Demographics

Schools

Forty schools were selected from a stratified random sampling based on zip code and 6^{th} grade enrollment. The number of schools to be selected was not pre-determined. Rather, the selection was based on achieving a student sample of approximately 3,700. Six physiographic regions exist throughout the state – Ozarks, River Valley, Central, Delta, Ouachitas, and Gulf Coastal Plain (sometimes referred to as the Timberlands). Each physiographic region has its own unique culture, natural resources, and industry which can impact the regional education. Geographic regions were divided into northwest, northeast, central, southwest and southeast. The physiographic boundaries are shown in Figure 4.1.a while the geographic regions are depicted in Figure 4.1.b. The frequency distributions (as a percentage) of the schools within both sets of regional boundaries are shown in Table 4.1.

Source: www.stateparks.com/ar.html

Figure 4.1.a. Physiographic Regions of Arkansas



Source: Arkansas Geological Survey, 2012

Figure 4.1.b. Geographic Regions of Arkansas

Table 4.1.

Distribution of Schools Based on Provinces

Physiographic Province	Schools (%) In Population	Schools (%) In Sample
Ozarks	23.4	20.0
River Valley	13.0	12.5
Ouachitas	13.4	15.0
Central	16.0	10.0
Delta	19.0	25.0
Timberlands	15.2	17.5
Geographic Province		
Northwest	28.4	27.5
Northeast	20.9	22.5
Central	21.6	12.5
Southwest	16.0	17.5
Southeast	13.1	20.0

The sampled population was lower than is representative of the statewide population for the Ozarks and Central physiographic regions. The sampled population was higher than the school population for the Delta and the Timberlands. This takes into account only the number of schools located within the regions; not the student population within the regions. The sampled population was smaller than the total population for the Central region when evaluating geographic province. Sampling was higher within the Southeast region. Again, these data are based on numbers of schools rather than numbers of students.

Each school was assigned a unique code for analysis purposes. The school codes were capital letters beginning with A and ending with NN.

Teachers

Sixty 6th grade science teachers were employed by the 40 participating schools. Fifty-eight teachers responded to the Teacher Information Form and Survey. Nearly 47% of the teachers who responded have taught for fewer than 10 years. Forty one percent have taught for 10 to 20 years and 12% have taught for more than 20 years. The percentage of female teachers to male teachers was 87.9% to 12.1%, respectively. Bachelor's degrees were held by 65.5% of the teachers while Master degrees were held by 31% of the teachers. The majority of the teachers (56.9 %) were between the ages of 31-50 years. Only eight teachers were under the age of 30 (13.8 %). Seventeen teachers (29.3 %) were over the age of 50. The majority of the teachers were white (82.9 %). Seven teachers (12.1%) reported their ethnicity as black while three (5%) reported their ethnicity as biracial or multiracial. As with the schools, each teacher was assigned a unique identification code that included a capital letter or letters representing the school code followed by a lowercase letter or letters ranging from "a " to "kkk" which was then followed by a number if there was more than one teacher at a given school (e.g. Jq1).

Students

The target population consisted of approximately 37,000 6th grade students enrolled in Arkansas public schools during the 2012-2013 school year. The cumulative enrollment at the 40 schools selected was 4,309. This represented the sampling fraction. A total of 3,446 students took the MSELS. The other students were either absent on the day of testing, were excluded from the study by parental request, had response forms too incomplete to score, or clearly did not participate in the survey as evidenced by their making patterns in their responses on the Scantron sheets. The total participation rate was therefore 79.97% of the maximum selected for participation. Males made up 50.6% of the sampling fraction while females accounted for

49.4%. Twenty- six students responded with an inappropriate answer and one student failed to identify his or her gender.

Table 4.2 depicts the ethnic make-up of the student sample. The majority of the students sampled were white (64.1%). Another 18.2% self-reported they were black. American Indian/Alaskan Native, Asian/Pacific Islander, Hispanic, and bi-racial collectively accounted for 17.7% of the student sample. Data retrieved from the National Center for Educational Statistics (http://nces.ed.gov/programs/stateprofiles) indicate the distribution from this sample is similar to the population of all students in Arkansas. Data for 6th grade alone were not readily available.

Table 4.2.

Student Self-Reported Ethnicity and Ethnicity Reported Statewide

Ethnicity	6th Grade Student Sample		Student Population*	
	Frequency	Percent	Frequency	Percent
American Indian/Alaskan Native	226	6.6	3,369	<1
Asian/Pacific Islander	54	1.6	8,979	1.9
Hispanic	270	7.8	47,340	9.8
Black	628	18.2	103,637	21.5
White	2,205	64.1	312,372	64.8
Bi-racial	59	1.7	6,417	1.3

* Data obtained from the National Center for Education Statistics

Data Analysis

Research Question 1*:* What is the level of environmental literacy of sixth grade students across Arkansas on the key concepts included in the MSELS and how do these findings compare to the national baseline data?

Data were aggregated for the entire state to address the first research question. Data are reported in the form of descriptive statistics as summarized in Table 4.3. Part I was not included as these questions provided student demographic data. The sample sizes (n) for each part of the MSELS varied as some students did not complete enough questions to be scored. The Ecological Foundations (Part II) and the Issue Identification, Issue Analysis, and Action Planning (Parts VII.A/B/C) were broadly defined as cognitive scales since there were correct and incorrect answers to the questions. Students scored much higher, on average, on the ecological foundations (61.8% answered correctly) than on the cognitive skills components – issue identification, issue analysis, and action planning (33.4% answered correctly).

Table 4.3.

Descriptive Statistics for Aggregated Data For Parts of the MSELS.

Parts of MSELS	Sample Size (n)	Range	Mean	SD	Percent Correct
II. Ecological Foundations	3446	0-17	10.52	3.42	61.8
III. How You Think About the Environment	3428	12-60	42.08	8.92	70.1
IV. What You Do About the Environment	3412	12-60	35.95	9.05	---
V. You and Environmental Sensitivity	3396	11-55	33.19	7.43	---
VI. How You Feel About the Environment	3367	2-10	8.22	2.14	---
VII.A. Issue Identification	3446	0-3	0.82	0.85	27.3
VII.B. Issue Analysis	3446	0-6	2.12	1.71	35.3
VII.C. Action Planning	3446	0-20	6.76	5.14	33.8

Students were more able to answer multiple-choice general ecological content questions than to read short passages and identify environmental issues and recognize acceptable action strategies to resolve issues. Parts III, IV, V, and VI were Likert-style responses with higher scores indicating a more positive response. Comparison of the intention to act scale (Part III) with the actual behavior scale (Part IV), showed students scored higher, on average, on the intention to act (mean = 42.08 out of 60) than on the actual self-reported behavior (mean = 35.95 out of 60). For environmental sensitivity (Part V), students scored an average of 3.19 out of 55. These findings were comparable to the self-reported behavior but were lower than the intention to act scale. On average, the highest scores were reported for general environmental feelings (Part VI) (8.22 out of 10).

These findings are similar to those reported in the *National Environmental Literacy Assessment Project: Year 1, National Baseline Study of Middle Grades Students, Final Research Report* (McBeth et al., 2008). A comparison of the findings for Arkansas students and the national baseline data is presented in Table 4.4. Statistically significant differences were found within the scales of ecological foundations, intention to act, behavior, issue analysis and action planning. In all cases, the Arkansas students scored significantly lower, on average, than the baseline data for the nation. The differences, however, had small effect sizes (Cohen's *d* values) ranging from 0.008 to 0.292. The significant differences were likely the result of the large sample sizes for both studies.

MSELS Part II – Ecological Foundations

The mean for the aggregated statewide data for the ecological foundations (knowledge) component of the survey was 10.52 out of a possible 17 points or 62%. The mean was slightly lower than the median (11.0) and the mode (12) indicating the distribution of scores was slightly negatively skewed. Scores ranged from a low score of one correct answer (8 students) to a maximum score of 17 correct answers (55 students). Item difficulty is the percentage of students who answered a test question correctly. Low item difficulty values indicate difficult items

Table 4.4.

Results of t-test Comparisons of Arkansas and National Samples.

Variables	Sample	n	Mean	SD	t-statistic	Effect size***
II. Ecological Foundations	Arkansas	3446	10.52	3.42	5.763**	0.174
	National*	934	11.24	3.26		
III. How You Think About the Environment	Arkansas	3428	42.08	8.92	5.643**	0.169
	National	1000	43.89	8.94		
IV. What You Do About the Environment	Arkansas	3412	35.95	9.05	7.575**	0.229
	National	974	38.44	9.04		
V. You and Environmental Sensitivity	Arkansas	3396	32.54	7.43	0.259	0.008
	National	978	32.47	7.47		
VI. How You Feel About the Environment	Arkansas	3367	8.14	2.14	1.572	0.048
	National	987	8.26	2.00		
VII.A. Issue Identification	Arkansas	3446	1.31	0.85	0.618	0.019
	National	902	1.33	0.92		
VII.B. Issue Analysis	Arkansas	3446	2.12	1.71	9.644**	0.292
	National	905	2.75	1.89		
VII.C. Action Planning	Arkansas	3446	6.76	5.14	2.487**	0.075
	National	874	7.25	5.44		

* National baseline data represented as weighted data
** Significant at the alpha=0.05 level
*** Cohen's d effect size

whereas high item difficulty values indicate easier items. Table 4.5 contains the item difficulty values for each of the 17 questions in the ecological foundations section of the MSELS. The data presented include a comparison of item difficulty for the Arkansas survey and the national survey. The item difficulty ranged from a low of 0.36 (Item 18) to a high of 0.93 (Item 6) for the Arkansas students surveyed. Four items (9, 13, 18, and 19) were particularly difficult (item difficulty less than 0.50). Item 6 was the least difficult with 93% of the students responding correctly. Six items (Items 5, 8, 14, 15, 16, and 21) were moderately difficult with item difficulty values ranging from 0.5 to 0.65.

Table 4.5.

Item Difficulty Comparison for the Ecological Foundations Part of MSELS

Item #	Study	Item Difficulty	Item #	Study	Item Difficulty
5	National	0.66	14	National	0.56
	Arkansas	0.65		Arkansas	0.59
6	National	0.92	15	National	0.52
	Arkansas	0.93		Arkansas	0.51
7	National	0.78	16	National	0.58
	Arkansas	0.69		Arkansas	0.58
8	National	0.50	17	National	0.79
	Arkansas	0.55		Arkansas	0.73
9	National	0.67	18	National	0.35
	Arkansas	0.44		Arkansas	0.36
10	National	0.81	19	National	0.54
	Arkansas	0.83		Arkansas	0.46
11	National	0.71	20	National	0.84
	Arkansas	0.69		Arkansas	0.74
12	National	0.82	21	National	0.64
	Arkansas	0.79		Arkansas	0.53
13	National	0.43			
	Arkansas	0.45			

Based on the item difficulty analysis, four items were particularly troublesome for the students. One asked about the relationship between termites and the tiny organisms that live inside their intestines to help them digest wood (Item 9). Only 44% of the students answered correctly. Termites are common in Arkansas with the U. S. Forest Service classifying Arkansas in the moderate to heavy termite pressure zone. Termites are active across the state. According to the Science Curriculum Framework, students in the 4th grade should learn about the interdependence of organisms in the ecosystem (LS.4.4.2). In 5th grade the students should learn about symbiotic relationships including parasitism, mutualism, and commensalism (LS.4.5.17). Instruction in both 4th and 5th grade should have prepared the students to answer Item 9. As a comparison, 67% of the students participating in the national study answered the question correctly. Item 13 was only answered correctly by 45% of the students in Arkansas. This question required students to understand the interrelatedness of species within a food chain and what happens when one member of the chain is removed from the system. Students should have learned these concepts in the 5th and 6th grades (LS.4.5.4. and LS.4.6.2.). As a comparison , 43% of the students nationwide answered the question correctly, indicating students had a problem answering a question that was likely within the "understanding" category of Bloom's Taxonomy (Anderson et al., 2000). Item 6 also dealt with food chains but was worded as a definitional question simply requiring recall by the student. This would equate to "remembering" in Bloom's Taxonomy, the lowest level of the cognitive domain. Ninety-three percent of the students answered this item correctly. These findings emphasize that students memorize isolated facts but cannot transfer that learning to a higher level of application. The third and fourth Items (18 and 19) both dealt with the concept of energy and nutrient flow through ecosystems. Correct answers were given by 36% and 46% of the students for items 18 and 19, respectively. Item 18 required students to understand the energy pyramid which they should have learned in the 5th grade (LS.4.5.2.). Item 19 required knowledge of nutrient cycling which is not specifically covered in the K-6 Arkansas frameworks. Student performance on each of these questions highlights the inability of students to apply knowledge or analyze situations to solve problems.

MSELS Part III. How You Think About the Environment

This section of the MSELS was framed in the form of a Likert-type scale (no correct or incorrect answers) which is considered to be ordinal rather than interval in nature. Therefore, reporting means does not accurately represent the findings. Rather, medians and frequency distributions were used to characterize the data. This scale was designed to measure students' verbal commitment to act on behalf of the environment, as one measure of the environmental affect or disposition domain. Frequency distributions for Items 22 through 33 are presented in Table 4.6. The frequencies are reported in percentages of students responding to the measure.

The items in Part III focus on a willingness or intention to act on environmental issues such as protecting animals, energy and water conservation, recycling, and encouraging others to act. Students generally responded positively to the intent to act. Student responses were contradictory in a number of cases. For instance, for Item 23 (after reverse coding) only 45.1% of the students were willing to save energy by using less air conditioning based on their responses of "Very True" and "Mostly True." Yet students responded more positively (52.2% responded "Very True" or "Mostly True") to Item 29, which also dealt with the conservation of energy. Approximately 46% of the students responded with a willingness to stop buying products to save animals' lives (Item 22). However, 59.1% expressed a willingness to give their own money to help protect wild animals (Item 28).

A similar pattern was seen with water conservation. Approximately 55% of the students said they would be willing to use less water when they bathe (Item 24). However, nearly 80% said they would be willing to save water by turning the water off when brushing their teeth (Item

30). Fewer students were willing to act when the action involved communicating with others (Items 31 and 32). Only 49.8% of the students expressed a willingness to pass out environmental information about a local issue and only 44.5% would be willing to write letters asking people to help reduce pollution. An exception was seen with Item 33 where 60.8% of the students responded with a willingness to ask people who don't recycle to start doing so.

Table 4.6.

Frequency Distributions of Items Measuring Intention to Act (Part III)

Item	n	Missing	Very True	Mostly True	Not Sure	Mostly False	Very False
22	3433	13	20.2**	25.7	29.2	9.9	14.6
23*	3432	14	21.9	23.2	27.0	15.5	11.9
24	3432	14	27.4	27.7	18.6	11.4	14.6
25*	3432	14	29.1	23.4	25.2	11.7	10.2
26	3431	15	25.3	24.1	25.9	11.8	12.4
27*	3426	20	33.3	20.0	22.0	11.6	12.4
28	3430	16	33.1	26.0	21.4	8.6	10.5
29	3431	15	28.9	23.3	24.9	10.3	12.2
30	3426	20	63.6	15.6	9.5	4.3	6.3
31	3424	22	26.8	23.0	30.2	8.3	11.0
32	3430	16	21.9	22.6	28.5	12.4	14.1
33	3429	17	36.5	24.3	20.1	8.3	10.1

* Item was negatively worded; frequency distributions represent reverse scoring
** Percentage of students responding

The patterns from these data indicate students show a willingness to act when it does not involve a reduction in their personal "comfort." For instance they were willing to use dimmer light bulbs but were less willing to reduce their use of air conditioning. They were willing to turn the water off when brushing teeth, but were not as willing to use less water when they bathe.

MSELS Part IV. What You Do About the Environment

Frequency distributions for the students' self-reported environmental behaviors were lower than corresponding frequency distributions from the intent to act that made up Part III of the survey (Table 4.7). In Part III, 44.5% of the students were willing to alert someone about a pollution problem in writing. Yet fewer than 20% of the students self-reported having done so. Eighty percent of the students reported a willingness to turn off the water while brushing their teeth. Yet only 68.7 percent of the students responded positively (by marking "Very True or "Mostly True" to Item 36) that they actually do turn off the water while brushing their teeth. This pattern was similar to the behavior responses for Item 42 where 70.5% of the students indicated that they let a water faucet run only when it is necessary. Nearly 53% of the students responded with a willingness to separate things at home for recycling. However, in Part IV only 36.5% of the students indicated they do separate things in the home for recycling while 45.5% indicated they do not. It is important to note that some students may not have the opportunity to recycle at home which could skew the results. Further, not all recycling programs require separation of recyclables. In both Parts III and IV, these items were negatively worded. There may have been some confusion on the students' part regarding how to accurately answer the items.

Part V. You and Environmental Sensitivity

The items in Part V were designed to measure students' environmental sensitivity or their positive feelings toward the environment. The scale was Likert-type with choices ranging from "To a Great Extent" to "To No Extent." Table 4.8 depicts the frequency distributions for each item reported as a percentage of students responding accordingly.

Table 4.7.

Frequency Distributions of Items Measuring Self-Reported Behavior (Part IV)

Item	n	Missing	Very True	Mostly True	Not Sure	Mostly False	Very False
34*	3419	27	12.5	6.9	13.0	10.3	56.4
35	3422	24	16.5	17.2	15.0	14.2	36.4
36	3418	28	50.7	18.0	9.7	8.2	12.6
37	3415	31	45.7	24.9	9.9	9.4	9.1
38	3415	31	14.0	9.6	20.0	12.2	43.2
39	3411	35	25.4	19.8	17.5	12.9	23.4
40	3411	35	12.8	12.9	20.8	15.9	36.6
41	3414	32	12.8	14.9	17.4	17.4	36.6
42	3411	35	44.6	25.9	13.8	6.8	7.9
43	3408	38	24.8	17.6	13.2	16.2	27.1
44	3404	42	39.4	13.3	11.1	8.3	26.7
45*	3413	33	22.4	14.1	17.0	15.7	29.8

* Item was negatively worded; frequency distributions represent reverse scoring.

Item 46 asked the student to supply a self-rating of his or her own level of environmental sensitivity. Approximately, 36% of the students rated themselves as environmentally sensitive to a “Great” or “Large” extent, while 24.3% rated themselves as environmentally sensitive to a “Small” or “No” extent. These findings were higher than the national baseline study where only 22% of the sixth grade students rated themselves as environmentally sensitive to a “Great” or “Large” extent. Thirty-nine percent of the Arkansas students self-rated their environmental sensitivity as “Moderate” which was similar to the 41% reported in the national baseline study.

Item 47 asked the student to self-report the environmental sensitivity of their entire family. Only 33% of the students rated their families as environmentally sensitive to a “Great” or “Large” extent, and nearly 30% rated their household environmental sensitivity as to a

"Small" or "No" extent. The highest percentage (37%) rated their families as "Moderate." Students in Arkansas reported a greater extent of environmental sensitivity within their families than did the national sample (23%).

Table 4.8.

Frequency Distributions of Items Measuring Environmental Sensitivity (Part V)

Item	n	Missing	Great Extent	Large Extent	Moderate Extent	Small Extent	No Extent
46	3406	40	16.7*	19.3	38.6	15.4	8.9
47	3403	43	13.7	19.0	36.8	18.7	10.7
48	3404	42	42.7	23.0	19.2	8.6	5.2
49	3407	39	33.6	16.2	18.6	16.2	14.2
50	3407	39	19.3	13.8	19.4	19.1	27.2
51	3399	47	13.4	8.9	16.1	17.5	42.7
52	3398	48	12.2	11.0	16.1	15.6	43.7
53	3394	52	32.4	22.1	22.4	12.5	9.2
54	3394	52	13.6	13.7	24.6	24.4	22.3
55	3389	57	21.2	15.8	23.4	20.6	17.2
56	3387	59	19.3	15.5	25.2	17.8	20.5

* Percentage of students responding

Items 48 to 53 refer to student contact with the outdoors. Approximately 66% of the Arkansas students responded that their families go on vacations or outings in the outdoors. This is much higher than the baseline data which indicated only 16% of students took part in family outdoor vacations. This finding may be a reflection of the diversity in natural resources available in Arkansas where opportunities for outdoor exploration abound. In response to Item 49, 50% of the Arkansas students reported they hunt or fish to a "Great" or "Large" extent. This number is lower than the national baseline (58%). Thirty-three percent of the students indicated they hike, canoe, and/or kayak to a "Great" or "Large" extent. Most students did not engage in birdwatching and nature photography (22.3% to a "Great" or "Large" extent; 17.5% to a "Small" extent; 42.7% to "No" extent). These findings are in direct contrast to the national baseline where the majority of the students (63%) reported engaging in these activities to a "Great" or "Large" extent. Less than one-fourth of the students reported camping with youth groups or organizations, while 44% indicated they never do. Over 50%, however, indicated they spend time in the outdoors alone, not as part of a class or group. These findings contradict the national baseline data which found students were more than twice as likely to engage in outdoor activities as part of a group than on their own.

The final three items (Items 54 to 56) explored other potential influences on the students' reported environmental sensitivity including reading, watching media, and the influence of teachers or youth leaders. Only 27.3% of the Arkansas students enjoy reading books or magazines about nature and the environment to a "Great" or "Large" extent. Nearly the same percentage (22.3%) indicated they enjoy it to "No" extent. Thirty-seven percent of the students enjoy watching television shows, videos, CDs, or DVDs about nature and the environment, while 17.2 % still reported they do not watch nature shows at all. Thirty-five percent indicated they have a teacher or youth leader who is a role model for environmental sensitivity to a "Great" or "Large" extent. These findings contradict the national baseline data wherein a greater percentage of the students (48%) found reading books and magazines about nature and the environment to be more enjoyable than TV shows, videos, CDs, and DVDs (39%). The influence of teachers and/or youth leaders was similar in the two studies.

MSELS Part VI. How You Feel About the Environment

The two items in this scale were designed to measure the students' overall feelings about the environment. The items were written as opposites with responses in a Likert-type format from “Strongly Agree” to “Strongly Disagree”. The frequency distributions are presented as percentages in Table 4.9. The percentage of students who “Strongly Agree” or “Slightly Agree” to Item 57 was essentially equal to the percentage of students who “Strongly Disagree” or “Slightly Disagree” to Item 58. Item 57 was stated “I love the environment” and Item 58 was stated “I hate the environment.” Indeed, the percentage of students who responded to Item 57 in a positive fashion (higher than neutral) was 71.5%, whereas those who responded in a negative fashion (lower than neutral) to Item 58 was 73.2%. While it is evident the majority of the students have strong feelings toward the environment, it is inexplicable that 49% “Strongly Agree” they love the environment but 59% “Strongly Disagree” they hate the environment. One would expect these numbers to be the same.

Table 4.9.

Frequency Distributions of Items Measuring Environmental Feelings (Part VI)

Item	n	Missing (n)	Strongly Agree	Slightly Agree	Neutral Undecided	Slightly Disagree	Strongly Disagree
57 (Love)	3379	67	49.4	22.1	16.0	4.9	5.7
58 (Hate)	3375	71	6.4	6.2	12.1	14.2	59.0

MSELS Parts VII.A. and VII.B. Issue Identification and Issue Analysis

This section of the MSELS was designed to assess students’ ability to identify (3 items) and analyze (6 items) environmental issues. The items for this section were multiple-choice with correct and incorrect responses. Table 4.10 depicts the item difficulty for the nine items in these sections for the Arkansas survey and the national survey.

Students in the Arkansas study had more difficulty identifying the issues presented in the short passages than those students participating in the national study. The item difficulty ranged from 0.22 to 0.44. Thirty-seven percent of the Arkansas students responded correctly to Item 60 which was related to predators and agricultural herds. Only 22% and 23% of the students answered correctly on the other two issues which related to a forest ecology and timber harvest issue (Item 59) and a land use issue (Item 67), respectively. Based on the low percentage of correct responses, the students had difficulty understanding the issues or recognizing the issues within the context of the passage. The students responding in the national study were better at identifying the issues than were the Arkansas students although they, too, had difficulty identifying the issues within the context of the passage. The Arkansas students scored 10%, 21%, and 16% below the national baseline percentages for Items 59, 60, and 67, respectively.

Table 4.10.

Item Difficulty Comparison for the Issue Identification and Issue Analysis Sections

Sub-Scale	Item #	Study	Item Difficulty
VII.A Issue Identification Skills	59	Arkansas	0.22
		National	0.32
	60	Arkansas	0.37
		National	0.58
	67	Arkansas	0.23
		National	0.39
VII.B. Issue Analysis Skills	61	Arkansas	0.44
		National	0.55
	62	Arkansas	0.28
		National	0.34
	63	Arkansas	0.32
		National	0.41
	64	Arkansas	0.31
		National	0.40
	65	Arkansas	0.43
		National	0.56
	66	Arkansas	0.34
		National	0.44

In the Issue Analysis section students were asked to analyze the issue and determine the value represented by individual stakeholders within the scenario. The values were listed and described for the students. In addition, a sentence reference number was provided so students could quickly refer to the appropriate reference within the passage. The Arkansas students had difficulty differentiating and applying values. Across all items fewer than 45% of the students responded correctly. The Arkansas students scored an average of 10 percentage points below the national baseline.

After evaluating Arkansas students' performance on the MSELS and comparing the results to the national baseline, descriptive and inferential statistics were evaluated for the demographic variables of ethnicity and gender. One-way analyses of variance (ANOVA) tests were conducted with post-hoc pairwise comparisons to determine which ethnic groups were statistically different. Post hoc comparisons were made using Bonferroni tests where equal variances existed and Dunnett's C tests where data exhibited unequal variances (Green & Salkind, 2011). With respect to the knowledge component, all ethnicities scored significantly higher than the black students (See Table 4.11). Additionally, the white students scored significantly higher than the American Indian/ Alaskan Natives and Hispanics. The Asian/Pacific Islander, biracial, and white students scored significantly higher in environmental affect than the black students. No other significant differences in environmental affect were noted when comparing group differences. All ethnic groups scored significantly higher than the black and American Indian/Alaska Native students in the cognitive skills domain. No significant group differences were identified based on ethnic group for the behavior domain. Composite environmental literacy scores were significantly higher for the Asian/Pacific Islander student group. All ethnic groups scored statistically significantly higher than the black students on overall environmental literacy. No other significant differences were noted between the ethnic groups.

One-way analyses of variance (ANOVA) on the environmental literacy dependent variables was conducted to determine if group differences existed for gender. The ecological knowledge, cognitive skills, and overall environmental literacy variables were not significantly different (See Table 4.12). The females scored significantly higher than the males on the environmental affect and behavior domains, but the effect sizes were small.

Table 4.11.

Means and Standard Deviations on the Dependent Variables by Ethnic Group

Ethnic Groups	Knowledge		Affect		Cognitive Skills		Behavior		Composite Environmental Literacy	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
American Indian/Alaskan Native	35.24	13.00	40.73	6.96	13.30	9.82	37.25	9.13	126.52	22.88
Asian/Pacific Islander	38.48	13.13	41.50	7.35	17.48	12.09	39.37	10.09	136.82	28.10
Hispanic	35.60	11.89	39.57	6.79	15.95	10.44	36.32	9.37	127.44	22.93
Black	30.46	11.35	39.01	6.38	12.30	6.18	35.65	8.35	117.41	20.00
White	39.58	11.31	40.41	7.05	16.12	10.76	35.67	9.15	131.78	24.23
Bi-racial	36.77	12.90	41.16	7.60	16.00	10.5	37.85	9.27	131.78	24.24

Research Question 2: What are the composite levels of environmental literacy of 6th grade students across Arkansas and how do these findings compare to the national baseline data?

Prior to the National Environmental Literacy Assessment (McBeth et. al., 2008) there were no quantitative standards or norms for environmental literacy. The NELA data provided the first standard against which assessments such as this large-scale assessment of Arkansas' students could be compared. Four constructs or domains of environmental literacy are widely recognized including ecological knowledge, environmental affect, cognitive skills, and behavior. Table 4.13 identifies where the individual parts of the MSELS fit into these four components of environmental literacy.

Table 4.12.

Means and Standard Deviations on the Dependent Variables by Gender

Gender	Knowledge		Environmental Affect		Cognitive Skills		Behavior		Composite Environmental Literacy	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Females	37.32	11.37	40.64	6.69	15.20	10.47	36.37	9.03	129.53	24.09
Males	37.38	12.61	39.67	7.15	15.33	10.60	35.46	9.07	127.84	23.94

In order to combine results and derive a composite score of all literacy components, the means on the individual sections of the MSELS were adjusted with multipliers based on the range of possible scores so that the sum of each of the four components was equal to 60. Multipliers included 3.529, 0.5, 0.4615, 0.4615, 6.67, 3.33, 1.00, and 1.00 for the ecological knowledge, verbal commitment, environmental sensitivity, environmental feeling, issue identification, issue analysis, action planning, and actual commitment conceptual variables, respectively. The total possible composite score was 240 with a range of 24 to 240 with each of the four components of environmental literacy contributing equally (60 points each) to the composite score. The scores of the components of environmental literacy and the overall composite scores were further categorized into levels of environmental literacy to allow for direct comparison with the national baseline. The ranges reported by NELA were low (0-20), moderate (21-40), and high (41-60).

Table 4.13.

Components of Environmental Literacy and Composite Scores for Arkansas Students and the National Baseline.

<table>
<tr><th rowspan="2">Parts of the MSELS</th><th rowspan="2">Domains of Environmental Literacy</th><th rowspan="2">Sample</th><th rowspan="2">Combined Component Mean*</th><th colspan="2">Environmental Literacy Composite Scores **</th></tr>
<tr><th>AR</th><th>Natl.</th></tr>
<tr><td>Ecological Foundations</td><td>A. Ecological Knowledge</td><td>AR***
Nat'l.</td><td>37.12
39.67</td><td rowspan="8">128.58</td><td rowspan="8">143.99</td></tr>
<tr><td>How You Think About the Environment</td><td rowspan="3">B. Environmental Affect</td><td rowspan="3">AR
Nat'l</td><td rowspan="3">40.16
40.73</td></tr>
<tr><td>You and Environmental Sensitivity</td></tr>
<tr><td>How You Feel About the Environment</td></tr>
<tr><td>Issue Identification</td><td rowspan="3">C. Cognitive Skills</td><td rowspan="3">AR
Nat'l.</td><td rowspan="3">14.96
25.15</td></tr>
<tr><td>Issue Analysis</td></tr>
<tr><td>Action Planning</td></tr>
<tr><td>What You Do About the Environment</td><td>D. Behavior</td><td>AR
Nat'l.</td><td>35.95
38.44</td></tr>
</table>

* Total possible points = 60
** Total possible points = 240
*** "AR" refers to Arkansas scores while "Nat'l" refers to national baseline scores

In evaluating the individual components of environmental literacy, the ecological knowledge had a component mean of 37.12 out of a possible 60. On average, the Arkansas students scored within the moderate range. Although the mean for the national baseline was slightly higher than the Arkansas survey (39.67), the national results also fell within the moderate range. Slightly higher scores were obtained for environmental affect with a combined component mean of 40.16 for the Arkansas survey and 40.73 for the national survey. The categorical ranges identified by the NELA for the affective domain were low (12-27), moderate

(28-44), and high (45-60). The Arkansas students and the national students scored within the moderate range for environmental affect. Both environmental dispositions and behavior share the same range (12-60) and thus the same range levels.

The means for the behavior component (35.95 for Arkansas survey and 38.44 for national survey) were lower than the means for environmental affect. However, both Arkansas and national means fell within the level of moderate environmental literacy. The lowest scores observed were in the cognitive skills domain with the Arkansas students averaging just 14.96 out of 60. The students surveyed for the NELA scored much higher with a mean of 25.15. With a range of 0-60 the environmental literacy levels for behavior were identified as low (0-20), moderate (21-40), and high (41-60). The Arkansas students scored within the low range while the students surveyed nationally scored within the moderate range for environmental behavior.

All of the component scores were combined to report an overall environmental literacy composite score. Three levels of environmental literacy were identified by the NELA: low (24-96), moderate (97-168), and high (169-240). The composite scores for the Arkansas students averaged 128.58 which fell within the moderate range. The composite score for the national baseline averaged 143.99 which also fell within the moderate range. Results were analyzed with the independent-samples t test. The analysis revealed a significant difference between the composite score means of the Arkansas students and those of the national baseline, t (4110) = 15.41; $p < 0.01$. The national baseline was significantly higher than the results of the Arkansas survey. The effect size was computed as d = 0.583. According to Cohen's (1992) guidelines for t tests, this represents a moderate effect size.

Results indicated the Arkansas students were less environmentally literate than the national baseline. The students were particularly lacking in the cognitive skills component of environmental literacy which relies on the students ability to identify and analyze environmental issues as well as plan action strategies. These skills enable students to recognize and solve problems by applying what has been learned.

Research Question 3: To what degree does the environmental literacy of Arkansas students' differ and/or correlate based on the key school-level demographic information?

Schools

Student scores were averaged for each of the 40 schools to determine the likely influence of school attributes on student environmental literacy. Mean data from the school level were then used to make comparisons. Table 4.14 presents the descriptive results for each of the 40 schools for the combined component means (four domains of environmental literacy) and total environmental literacy composite scores. The lowest scores for each of the domains of environmental literacy were attributed to two schools, R and S. The highest scores for each of the domains were attributed to one school, V. In addition, School V had the highest composite environmental literacy score (151.21) while School S had the lowest composite score (106.45). School V was the only school that scored at or above the national baseline composite score of 143.99.

Table 4.14.

Descriptive Statistics for Combined Component Means by School

School Code	n	Mean SD	Ecological Foundations	Environmental Affect	Cognitive Skills	Behavior	Composite Score
A	246	Mean	35.43	40.83	13.56	37.61	127.45
		SD	11.64	5.94	9.40	7.92	20.44
AA	76	Mean	41.56	40.57	20.00	34.59	136.73
		SD	9.96	7.31	10.45	9.52	22.99

School Code	n	Mean SD	Ecological Foundations	Environmental Affect	Cognitive Skills	Behavior	Composite Score
B	71	Mean	40.56	42.76	16.00	37.70	137.02
		SD	11.25	6.72	10.65	9.97	21.69
BB	106	Mean	35.42	38.91	14.95	36.80	126.58
		SD	12.63	6.58	11.96	9.37	23.79
C	26	Mean	33.66	38.95	16.23	35.27	124.11
		SD	10.34	5.65	9.93	7.41	17.37
CC	60	Mean	39.35	39.89	17.47	35.20	131.91
		SD	11.12	7.83	10.92	10.43	28.82
D	67	Mean	39.98	41.99	13.51	36.30	133.01
		SD	11.43	6.28	10.72	8.82	22.05
DD	182	Mean	37.40	40.35	14.55	35.44	127.87
		SD	11.29	7.26	11.23	9.03	24.58
E	46	Mean	39.51	39.62	19.48	35.02	133.63
		SD	8.24	7.97	12.80	10.00	22.46
EE	102	Mean	38.06	38.68	15.30	34.42	126.78
		SD	10.44	7.44	9.14	9.16	22.58
F	118	Mead	34.72	39.17	11.41	34.73	120.34
		SD	12.28	6.71	9.38	9.07	22.14
FF	35	Mean	45.17	38.91	16.94	35.06	136.09
		SD	10.82	6.54	12.77	8.87	22.91
G	17	Mean	40.27	41.15	11.18	33.41	126.01
		SD	8.83	5.43	8.45	6.49	16.27
GG	40	Mean	36.97	41.14	14.58	36.95	130.19
		SD	11.69	6.44	10.49	9.02	23.65
H	167	Mean	38.99	39.88	19.41	36.21	134.72
		SD	11.21	6.03	10.96	8.97	23.56
HH	24	Mean	40.58	42.81	14.92	34.71	133.01
		SD	7.58	6.41	10.57	8.67	18.05

School Code	n	Mean SD	Ecological Foundations	Environmental Affect	Cognitive Skills	Behavior	Composite Score
I	222	Mean	42.65	39.26	16.58	34.58	133.25
		SD	11.33	7.05	11.39	9.17	25.95
II	115	Mean	33.88	42.62	16.72	36.95	130.52
		SD	10.98	6.90	10.34	9.43	23.32
J	90	Mean	38.11	41.46	14.68	38.19	132.68
		SD	9.81	7.36	9.63	8.84	21.92
JJ	60	Mean	37.11	40.00	15.75	36.88	129.75
		SD	13.08	6.72	10.80	7.81	23.27
K	20	Mean	40.23	37.92	13.20	32.55	123.90
		SD	10.07	9.20	6.14	9.92	25.37
KK	107	Mean	33.31	40.55	14.33	36.29	124.48
		SD	12.20	6.37	9.26	8.03	19.53
L	92	Mean	37.02	38.66	14.21	34.66	124.54
		SD	12.39	6.41	8.67	8.39	20.36
LL	275	Mean	35.59	40.12	13.80	36.60	128.17
		SD	11.98	7.38	11.34	9.65	26.82
M	99	Mean	39.25	39.53	19.34	34.51	132.62
		SD	13.53	7.47	11.72	8.42	27.23
MM	154	Mean	38.45	42.26	14.58	37.34	133.22
		SD	12.05	6.24	10.97	8.69	23.79
N	69	Mean	39.94	42.43	11.09	37.06	131.98
		SD	9.62	6.18	11.71	8.37	20.21
NN	41	Mean	40.28	37.89	13.73	34.66	126.56
		SD	13.01	9.65	9.57	11.70	29.33
O	64	Mean	26.30	37.66	11.38	35.22	111.28
		SD	13.23	6.04	8.89	8.41	20.35
P	78	Mean	40.54	40.69	14.92	34.55	130.89
		SD	9.73	6.96	10.18	9.15	24.65

School Code	n	Mean SD	Ecological Foundations	Environmental Affect	Cognitive Skills	Behavior	Composite Score
Q	70	Mean	40.89	41.01	16.54	35.49	133.92
		SD	11.38	7.32	10.54	9.90	27.34
R	57	Mean	41.36	36.54	14.91	30.67	123.47
		SD	9.70	7.55	9.68	9.51	25.49
S	21	Mean	25.88	37.29	8.14	34.50	106.45
		SD	11.98	6.90	6.37	8.04	17.52
T	105	Mean	26.01	38.18	9.79	37.90	111.88
		SD	11.92	5.56	7.66	8.19	19.44
U	19	Mean	31.20	41.86	14.00	37.53	124.59
		SD	10.93	3.28	8.67	6.18	18.46
V	26	Mean	47.23	43.90	21.96	38.12	151.21
		SD	10.33	6.40	12.49	9.59	22.28
W	29	Mean	41.01	39.78	18.83	34.38	134.00
		SD	10.89	7.01	10.71	9.14	24.89
X	80	Mean	29.73	40.63	13.24	36.32	119.93
		SD	10.50	7.25	9.58	9.31	21.91
Y	75	Mean	33.43	41.07	12.39	37.86	124.57
		SD	11.35	6.44	8.70	8.81	21.76
Z	95	Mean	37.12	40.15	14.96	35.95	128.58
		SD	12.07	6.94	10.62	9.05	24.03

Region of the state (physiographic and geographic), sixth grade enrollment, locale, and school configuration were all treated as categorical variables and were analyzed by one-way analysis of variance (ANOVA) unless otherwise noted.

Physiographic Regions

Arkansas is divided into 6 physiographic or resource regions by the Arkansas Geological Survey (Figure 4.1.a). Table 4.15 depicts the descriptive statistics for the each domain by physiographic region as well as the composite environmental literacy score by physiographic region. These data were analyzed for all students rather than by school means. Students from the Ozarks region scored, on average, highest on the knowledge and cognitive skills domains while the Ouachitas scored highest on the affect domain and the River Valley scored highest on the behavior domain. Students from the Delta region scored the lowest on each of the individual domains with the exception of behavior domain where students from the Ozarks region scored lowest. The Delta region also scored the lowest on the composite environmental literacy score while the River Valley scored highest.

Table 4.15.

Descriptive Statistics for Environmental Literacy Domains by Physiographic Province.

Region	School Sample Size (n)	Mean SD	Knowledge	Affect	Cognitive Skills	Behavior	Composite Score
Ozarks	8	Mean	39.35	39.65	16.20	35.04	130.56
		SD	11.43	7.67	10.61	9.54	25.65
River Valley	5	Mean	39.30	40.44	15.58	36.18	131.61
		SD	11.66	6.80	10.73	9.05	23.67
Central	4	Mean	37.88	39.38	15.88	35.91	129.49
		SD	11.96	7.11	11.05	9.36	24.29
Delta	10	Mean	33.28	39.33	13.78	36.03	122.60
		SD	12.76	6.57	9.57	8.60	22.31
Ouachitas	6	Mean	38.15	42.04	14.49	36.15	131.52
		SD	10.71	6.65	10.81	9.02	22.43
Timberlands	7	Mean	36.93	40.29	14.81	36.07	128.85
		SD	11.95	6.88	10.98	9.07	24.46

A one-way analysis of variance (ANOVA) was conducted to evaluate the relationship between physiographic location of participating schools (students) and the domains of environmental literacy. The independent variable, physiographic region, included 6 regions.

The dependent variables were ecological knowledge, environmental affect, cognitive skills, behavior, and composite environmental literacy scores. The ANOVA was significant for the ecological knowledge component, F (5, 3445) = 23.09; $p < 0.01$. The magnitude of the effect was computed as eta square = 0.032 which represents a weak effect. Differences based on physiographic location accounted for only 3% of the variance in the ecological knowledge component. Dunnett's C post hoc analyses at the alpha=0.05 level were performed because error variances were not equal. The Delta region was statistically significantly lower than all other regions. Additionally, the Ozarks and River Valley regions were statistically significantly higher than the Timberland region. Results for the environmental affect domain were statistically significant, F (5, 3362) = 8.41; $p < 0.01$. The Ouachita regions scored statistically significantly higher than all other regions. Additionally, the River Valley scored significantly higher than the Delta region. Results for the cognitive skills domain were significant, F (5, 3445) = 3.96; $p < 0.01$. The Ozarks and River Valley regions were significantly higher than the Delta region. Statistically significant differences were also found with respect to the composite environmental literacy scores, F (5, 3359) = 12.533; $p <0.01$. Mean composite scores for the Delta region were significantly lower than the all regions.

Geographic Regions

Five geographic regions were used to evaluate student performance by school on the environmental literacy survey. These regions were identified by the Arkansas Geological Survey (2012) and included the northwest, northeast, central, southwest, and southeast regions, common designations used when making statewide comparisons. The map identifying the regions is Figure 4.1.b. Descriptive statistics by region are shown in Table 4.16. Students in the southwest region scored, on average, higher for the knowledge and affect components. Students in the central region scored highest on the cognitive skills domain whereas the southeast region had the lowest mean scores. The students from the southeast, however, had the highest scores on the behavior domain. The highest composite environmental literacy scores were recorded for students in the central region with the northeast region scoring lowest.

Table 4.16.

Descriptive Statistics for Environmental Literacy Domains by Geographic Region.

Region	Sample Size (n)	Mean SD	Knowledge	Affect	Cognitive Skills	Behavior	Composite Score
Northwest	11	Mean	39.45	40.27	15.64	35.33	130.77
		SD	2.65	1.90	2.40	2.21	4.27
Northeast	9	Mean	36.22	39.88	15.93	35.65	127.81
		SD	3.93	1.33	2.35	1.27	5.11
Central	5	Mean	39.49	40.55	16.85	36.00	132.87
		SD	4.55	1.98	3.07	1.46	10.48
Southwest	7	Mean	40.77	40.66	14.86	35.21	131.94
		SD	2.01	1.86	2.70	1.49	3.94
Southeast	8	Mean	31.77	39.54	11.98	36.31	120.43
		SD	2.57	1.76	2.27	1.36	7.75

A one-way ANOVA test was conducted to determine if there were significant differences between the schools from the various regions for each of the component environmental literacy domains as well as the composite environmental literacy score. Significant differences were found for the knowledge component, F (4, 39) = 7.78, $p < 0.01$. A strong effect size (eta square = 0.471) was calculated. The geographic location of a participating school accounted for 47.1% of the variance of the knowledge component. A Bonferroni post hoc test was conducted since error variances were equal. Schools in the northwest, central, and southwest regions scored significantly higher than the students from the southeast. There were no statistically significant differences between groups for the environmental affect or the behavior domains F (4, 39) = 0.518, p = 0.723 and F (4, 39) = 0.59, p = 0.673, for affect and behavior respectively). The cognitive skills domain was significant, F (4, 39) = 4.099, p = 0.008. The effect size was strong (eta square = 0.319), indicating the geographic location of the participating schools accounted for 31.9% of the variance in the cognitive skills domain. Bonferroni post hoc comparisons were conducted because error variances were assumed equal. Students from the northwest, northeast, and central regions all scored significantly higher than students from the southeast region. No other significant differences were noted when comparing group differences for the cognitive skills domain. Composite environmental literacy scores were also statistically significant, F (4, 39) = 4.633, p = 0.004. The effect size was strong (eta square = 0.346), indicating the geographic location of the participating schools accounted for 34.6% of the variance in composite environmental literacy scores. Dunnett's C post hoc tests revealed students from the northwest, central, and southwest regions scored significantly higher than students from the southeast region.

Sixth Grade Total Enrollment

The sixth grade enrollment was divided into three size groups for analysis. These included those schools with a 6^{th} grade enrollment of fewer than 50 (small), 50-100 (medium), and more than 100 (large) students. Nine schools had a 6th grade enrollment with fewer than 50 students; sixteen schools were classified as medium sized schools (50-100 students); and 15 schools were large with more than 100 sixth grade students. Based on the one-way analysis of variance (ANOVA) conducted for each of the four domains of environmental literacy and the composite environmental literacy score, no significant differences existed between the groups.

According to these results, enrollment size was not a significant factor in determining the environmental literacy of 6^{th} grade students in Arkansas.

Socio-Economic Status

The total percentage free and reduced lunch as reported by the National Center for Educational Statistics for the 2011-2012 school year was used to categorize the socio-economic status (SES) of each school. The percentage free and reduced lunch ranged from 33.76% to 100% with a mean of 69.33%. The Arkansas state average for 2012 was approximately 60% and the national average was 53.92%. Therefore, the students surveyed in this study (based on school statistics) were, on average, slightly higher in percent free and reduced lunch (lower in SES) than both the state and national average.

The percentage free and reduced lunch was treated as a continuous variable. Pearson correlation coefficients were computed for the relationships between percentage free and reduced lunch and each of the four measured environmental literacy domains. A significant negative correlation was found between SES and the ecological knowledge domain ($r = -0.374$). As the percentage free and reduced lunch increased, ecological knowledge scores decreased. No significant correlations were found between SES and the affective, cognitive skills, or behavior domains. However, there was a significant negative correlation between SES and composite environmental literacy scores ($r = -0.343$). Again, as the percentage free and reduced lunch increased, the mean composite environmental literacy scores decreased.

Locale

The locale of each school was determined by the school locale types defined by the National Center for Education Statistics as revised in 2006. The “urban-centric” classification system consists of four major locale categories – city, suburban, town, and rural. Each of these categories is divided into three subcategories (Table 4.17).

Table 4.17.

NCES Urban-Centric Locale Categories.

City, Large	Territory inside an urbanized area and inside a principal city with population of 250,000 or more.
City, Midsize	Territory inside an urbanized area and inside a principal city with population less than 250,000 and greater than or equal to 100,000.
City, Small	Territory inside an urbanized area and inside a principal city with population less than 100,000.
Suburb, Large	Territory outside a principal city and inside an urbanized area with population of 250,000 or more.
Suburb, Midsize	Territory outside a principal city and inside an urbanized area with population less than 250,000 and greater than or equal to 100,000.
Suburb, Small	Territory outside a principal city and inside an urbanized area with population less than 100,000.
Town, Fringe	Territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area.
Town, Distant	Territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area.
Town, Remote	Territory inside an urban cluster that is more than 35 miles from an urbanized area.
Rural, Fringe	Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster.
Rural, Distant	Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster.
Rural, Remote	Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.

Source: Office of Management and Budget (2000).

Only one school, School E, was located within a city and that was classified as a small city. Two schools, Schools AA and MM, were located within a suburb; School AA was within a large suburb while MM was located within a small suburb. Six schools were located within the town classification. School A was located within the town, fringe locale. School T was located within the town, distant locale and Schools F, LL, O, and Z were located in the town, remote category. Thirty-one schools were located within the rural major locale category. Fourteen were classified as rural, fringe, 11 as rural-distant, and 6 schools as rural-remote. For purposes of analysis, the categories were collapsed into two groups, urban (city and suburb) and rural (town and rural). The town grouping was included with the rural schools based on its definition of mileage from an urbanized area.

Independent samples t tests were conducted on the two groupings, rural and urban, for Arkansas school locations. Levene's Test for equality of variances was conducted. None of the Levene's tests was significant so the t values for equal variances were used for evaluating each of the four components of environmental literacy as well as the composite environmental literacy scores. No statistically significant differences were revealed. Thus, in this study, the school locale was not a predictor of student environmental literacy.

School Configuration

First, schools were categorized as to whether the sixth grade was part of an elementary school or a middle school. Seventeen schools were elementary schools and 23 schools were middle schools. Independent t tests were conducted to determine if there were significant differences between the school types for each of the four environmental literacy domains as well as composite environmental literacy scores. No statistically significant differences were revealed.

Data were also analyzed for differences based on the organization of teachers for the sixth grade as well as the curriculum organization. The teacher configuration was self-reported by the lead teacher into one of four categories; e.g. self-contained teaching, departmentalized teaching, cross-disciplinary team teaching, and other. Thirty-six schools reported using departmentalized teaching while four schools reported using cross-disciplinary team teaching. No schools reported using self-contained teaching or a configuration different from those described by the identified categories. Independent samples t tests were conducted for each of the four domains of environmental literacy as well as the composite environmental literacy scores. No statistically significant differences were revealed for any of the dependent variables tested.

The curriculum organization was also self-reported by the lead teacher. Again, four categories were identified for consideration – separate subjects with little or no integration, treatment of selected common themes in separate subjects, treatment of broad common themes through integration of subjects, and other. Sixteen schools reported teaching separate subjects with little or no integration. Twelve reported teaching selected common themes in separate subjects. Finally, 11 schools utilized broad common themes through integration of subjects. One school failed to answer the question. A one-way ANOVA was conducted to evaluate the relationship between curricular organization and the components of environmental literacy. The behavior domain was statistically significant, F (2, 36) = 3.589, p = 0.038. The effect size (calculated as eta square = 0.166) was large, indicating the curricular organization accounted for 16.6% of the variance in the behavioral domain. Based on Bonferroni post hoc pairwise comparisons, teaching curriculum as separate subjects with little to no integration resulted in a higher overall behavior scores (mean = 36.26, SD = 1.35) than the teaching of broad common themes through the integration of subjects (mean = 34.66, SD = 1.87). No other significant differences were noted.

Based on the results of this investigation, student environmental literacy is not significantly impacted by school configuration or the teacher and curricular organization of the school.

Benchmark Testing

Benchmark literacy and science scores reported for each school (not at the student level) were used as a source of continuous data and correlated to the measures of the domain scores and the composite environmental literacy scores. The benchmark scores were used from the previous 2011-2012 school year when the participating students tested were in the 5th grade. Pearson correlation coefficients are shown in Table 4.18. The knowledge and cognitive skills domains were significantly correlated to both the literacy and science benchmark scores. As benchmark scores increased, so did the students' environmental literacy based on the knowledge component and the cognitive skills component. The Pearson coefficient is a measure of effect size. Literacy and science benchmark scores are highly correlated to the ecological knowledge component. A strong correlation also exists between the benchmark scores and the cognitive skills domain. The environmental affect and behavioral domains are not significantly correlated with the literacy or science benchmark scores. The composite environmental literacy scores are also highly correlated with the literacy and science benchmark scores.

Table 4.18.

Pearson Correlation Coefficients for Environmental Literacy Domains and Composite Scores with Literacy and Science Benchmark Testing.

	Knowledge	Affect	Cognitive Skills	Behavior	Composite Score
Literacy Benchmark	0.527*	-0.006	0.493*	-0.229	0.453*
Science Benchmark	0.779*	0.042	0.592*	-0.210	0.659*

* Significant at alpha = 0.05 level

Research Question 4: To what degree do the levels of Arkansas students' environmental literacy differ based on teachers' self-reported use of environmental education curriculum and pedagogical strategies?

Sixty teachers were responsible for teaching sixth grade science at the 40 participating schools. Each teacher was asked to complete a Teacher Information Form and Survey. Fifty-eight teachers completed the survey; two did not. Each participating teacher also signed an informed consent prior to participation. Independent variables of interest included years of teaching experience; highest level of education; formal environmental education training (college classes); professional development in environmental education through workshops/ trainings; gender; age; ethnicity; and views on environmental education and views on the environment. The frequency of occurrence and percentage of occurrence for the independent variables are included in Table 4.19. Among the teachers responding, roughly 47 % had been teaching for 10 or fewer years. Nineteen percent had taught for 11-15 years while another 22% had taught for 16-20 years. Seven teachers had taught for more than 20 years.

The females (88%) greatly outnumbered the males (12%) in this study. Sixty-eight percent reported they had earned a Bachelor's degree and 32% had earned a Master's degree. Eighteen teachers (31%) were 41 to 50 years old. Eight teachers were still in their twenties and two teachers were over 60 years old. Approximately 26% of the teachers were in their thirties and 26% were in their fifties. The ethnic make-up of the teachers was not diverse. Nearly 83% of the participants were white. Only 12 % were black and 5% reported being bi-racial or multi-racial. No other ethnicities were represented among the teachers.

Teachers were asked two questions about their environmental education training. The first was the number of environmental education courses they had taken. Forty-seven teachers

(87%) reported they had never taken an environmental education course as part of their teacher preparation programs. In other words, less than 20% of the 6th grade science teachers in this study have taken an environmental education class. The second question asked how many

Table 4.19.

Self-Reported Characteristics of Participating 6th Teachers

Independent Variables	Category	Frequency	Percentage
Total Teaching Experience	1-5 years	15	25.9
	6-10 years	12	20.7
	11-15 years	11	19.0
	16-20 years	13	22.4
	>20 years	7	12.0
Gender	Male	7	12.0
	Female	51	88.0
Highest Degree Earned	Bachelors	38	67.9
	Masters	18	32.1
Age Group	21-30 years	8	13.8
	31-40 years	15	25.9
	41-50 years	18	31.0
	51-60 years	15	25.9
	>60 years	2	3.4
Ethnicity	Black	7	12.1
	White	48	82.7
	Bi-racial	3	5.2
Environmental Education Courses Taken	0	47	81.0
	1-3	9	15.5
	>3	2	3.5
Number of Environmental Education Workshops/Training	0	35	60.4
	1-3	15	25.9
	4-6	6	10.3
	7-10	1	1.7
	>10	1	1.7

environmental education workshops or professional development trainings the teachers have had while teaching. Sixty percent reported never having any sort of environmental education training. Twenty-six percent had taken between 1 and 3 training opportunities, 10% had 4 to 6 and only 3% had 7 or more workshops or professional development trainings on the environment or environmental education. The majority of these were half-day or full-day trainings.Next, the teachers were asked two questions about the importance of environmental education to; a) the students and b) to them personally. The results in Table 4.20 indicated that nearly 52% thought it was considerably important to expose students in K-12 to environmental education. Eighteen teachers (31%) felt it was extremely important to expose students to environmental education. By contrast, 53% of the teachers responding to the national survey indicated it was extremely important to expose students to environmental education during the K-12 years and 29% thought it was considerably important. A similar trend was noted with the second question regarding importance of environmental education to them personally.

Table 4.20.

Frequency Distributions (Expressed as Number of Respondents) of Teachers' Perceptions of Environmental Education

Component	Extremely	Considerably	Moderately	Slightly	Not at All
Importance of EE to students	18	30	10	0	0
Importance of EE to self	16	32	10	0	0

Approximately 55% of the teachers participating in the Arkansas survey felt it was considerably important but only 28% felt it was extremely important. Thirty-six percent of the teachers participating in the national survey felt environmental education was considerably important while the majority (51%) felt it was extremely important. The teachers in the Arkansas survey do not find environmental education as important personally as did the teachers in the national study. These feelings could certainly affect whether environmental education is incorporated into classroom learning or not.

The teachers were asked to rate their level of environmental sensitivity, that is, to what extent they appreciate and care for the environment. Results are shown in Figure 4.21. Fifty-seven percent of the participating teachers reported they are environmentally sensitive to a large extent while 26% were sensitive to a moderate extent. Only 10 teachers (17%) reported the highest level of environmental sensitivity ("To a Great Extent").

Table 4.21.

Frequency Distributions (Expressed as Number of Respondents) of Teachers' Perceptions of the Environment

Component	Great Extent	Large Extent	Moderate Extent	Small Extent	No Extent
Extent to which you are environmentally sensitive	10	33	15	0	0
Willingness to act on behalf of the environment	10	35	13	0	0

Three questions were asked about the classroom environment. Teachers were asked to identify teaching/learning settings used with their students in the science classroom. The responses to each teaching/learning setting are shown in Table 4.22, listed in descending order based on percentage of teachers who reported using the particular setting.

Classrooms, computer labs, and science labs are most frequently used by the teachers. Less than half of the teachers reported using field trips/study sites. School grounds and community settings were the least utilized teaching/learning settings. A number of teachers anecdotally (based on verbal conversations while collecting student survey data) indicated they do not have the financial resources to take the students on field trips as they once did. School grounds are not utilized for a number of reasons including time, fears of classroom management in the outdoors, and lack of resources within the school grounds. The teachers were also asked to identify the three teaching methods/strategies most commonly used in their 6th grade science classrooms. Eight teaching methods/strategies were provided from which to choose. Teachers were asked to select those most commonly used. Results are listed in Table 4.23 along with the frequency distributions (as percentages of those responding) for each method/strategy. Teaching methods/strategies are listed in decreasing order of percentage of use.

Table 4.22.

Frequency Distributions (Percentages) of Teaching/Learning Settings Used for Instruction by Teachers

Teaching/Learning Settings	Used	Not Used
Classrooms	96.5	3.4
Computer Lab	67.2	32.8
Science Lab	63.8	36.2
School Library	53.4	46.6
Field Trip/Study Sites	48.3	51.7
School Grounds	29.3	70.7
Community Settings	12.1	87.9

Based on the teachers' responses, discussion and hand-on strategies were the most widely used teaching approaches. Labs and cooperative learning were also used by over 50% of the teachers. Inquiry-based instruction was utilized by only 39.7% of the teachers. None of the teachers reported using service learning with their students.

The final question asked the teachers to rank four assessment approaches based on their importance for assessing student progress and/or performance. Table 4.24 depicts the ranked responses. Forty-two percent of the teachers ranked informal assessment (teacher observations, teacher questions/student responses, and student interviews) as the most important for assessing student progress in science. Traditional assessment (tests and quizzes) was second with 34.5%

of the teachers ranking it as their primary assessment approach. Nearly forty-five percent ranked alternative/authentic assessment (performance tasks, papers and objects, and other portfolio entries) as the second most important assessment strategy. The third most important assessment type was the traditional assessment (teacher-developed quizzes and tests). Standardized assessments were ranked last in terms of importance for assessing student progress, yet receives the most attention during the school year.

Table 4.23.

Frequency Distributions as Percentages of Teaching Methods/Strategies Used by Science Teachers Surveyed

Teaching Methods/Strategies	Used	Not Used
Hands-On	77.6	22.4
Discussion	72.4	27.6
Labs	62.1	37.9
Cooperative Learning	56.9	43.1
Projects	44.8	55.2
Inquiry-Based Instruction	39.7	60.3
Lecture	36.2	63.8
Service Learning	0.00	100.0

Table 4.24.

Frequency Distributions as Percentages of Assessment Strategies as Ranked by Teachers

Type of Assessment	Rank 1	Rank 2	Rank 3	Rank 4
Informal Assessment	**41.7**	20.0	18.3	13.3
Alternative/Authentic Assessment	19	**44.8**	24.1	5.2
Traditional Assessment	34.5	25.9	**36.2**	3.4
Standardized Assessment	3.4	8.6	15.5	**41.4**

Each of the variables discussed was analyzed for impact on the students' composite environmental literacy scores. No statistically significant differences were revealed between student performance and teacher responses.

The findings of this section indicated that, though differences exist among the 6th grade teachers, these differences alone do not impact the environmental literacy scores of the students. One important outcome of this section is the realization that the teachers are not trained to teach environmental education. Few teachers have had any formal environmental education training as part of teacher preparation programs. Further, as in-service teachers they have had very little environmental training by way of workshops or other professional development. This will be discussed further in Chapter 5.

Research Question 5: To what degree is there a correlation between environmental literacy and the students' self-reported level of engagement in outdoor activities? Further, to what degree does the availability of an outdoor classroom and/or community garden impact the students' environmental literacy?

To answer this research question, Items 48 to 53 were extracted from the data set and considered separately as a representation of student engagement in outdoor activities. In addition, data were analyzed based on whether the students were likely exposed to outdoor classrooms or outdoor gardens as part of their school instruction. This information was taken from the Environmental Program Information Form provided by each school.

For the analysis of Items 48 to 53 of the MSELS, responses were combined for a minimum possible score of 6 and a maximum possible score of 30. Data were collapsed into three categories based on the students' self-reported level of contact with the outdoors - low (6-13), medium (14-22), and high (23-30). One-way ANOVA tests were conducted to determine if there were group differences in any of the four domains of environmental literacy or the composite environmental literacy scores. Statistically significant differences were revealed between the groups for the knowledge component (F (2, 3377) = 4.426, p = 0.012), the affect component (F (2, 3344) = 504.39, p < 0.001), and the behavior component (F (2, 3373) = 160.669, p < 0.001). The effect size for the comparison of groups on the knowledge component was small (eta square = 0.0026), indicating less than 1% of the variability in scores was explained by student engagement with the outdoors. The significance was likely inflated by the large sample size. The environmental affect was significantly higher (mean = 45.44) for the students with the highest self-reported engagement with the outdoors. The lowest scores (mean = 32.95) were from the students with the lowest level of engagement with the outdoors. The effect size (eta square = 0.232) is large indicating 23% of the observed variability in affective scores can be attributed to the level of engagement with the outdoors. A similar pattern was revealed with the behavior component. Mean scores (mean = 39.94) were highest for the students with the highest reported engagement with the outdoors. A moderate effect size (eta square = 0.087) indicated nearly 9% of the variability in behavior scores can be attributed to engagement with the outdoors. The composite environmental literacy scores were also significant with those students reporting the highest level of outdoor engagement scoring the highest (mean = 136.98). The students in the low engagement category scored the lowest composite scores (mean = 116.16). The effect size was once again moderate (eta square = 0.054), indicating 5% of the variability in the composite scores can be accounted for by engagement with the outdoors. The pattern indicated that students scored higher levels of environmental literacy as their level of engagement with the outdoors increased. This has widespread implications for environmental education reform and will be discussed in Chapter 5.

Data were grouped into students who likely have outdoor contact based on the use of the school grounds, either through the use of an outdoor classroom or a community garden. Two thousand one hundred thirty-four students (62.9% of those surveyed) attend a school that does not have an outside classroom or a community garden. Approximately 1,312 students (38.1% of those surveyed) attend a school that does have an outside classroom or community garden. Though significant differences were found using independent t tests, the effect size (Cohen's d = <0.20) was small, indicating very little of the variability can be attributed to the presence of an outdoor classroom or garden on the school grounds. Even when these settings were present, the amount of use for instructional purposes was reported by the teachers to be limited. Of the 15 schools that reported having outdoor classroom space and/or a community garden, most reported that the space is not used often. Four schools have vegetable gardens built with funds from the Arkansas Childrens Hospital Research Institute (ACHRI) Delta Garden Project. Grant funding is provided by ACHRI to build and maintain vegetable gardens on the school campus and provide training for teachers and garden participants on how to integrate the garden into science and other curriculum. Teachers reported the gardens are generally maintained through after-school garden clubs (with limited participation) and are geared toward certain grade levels. Four of the schools that reported having outside space indicated the space is used only in grades 7 through 12.

Research Question 6: What are the differences and similarities assessed by the survey between the three highest performing schools and the three lowest performing schools on this environmental literacy survey?

The lowest scoring schools were S (Mean composite = 106.45), O (Mean composite = 111.28), and T (Mean composite = 111.88). A gap was noted between these three schools and the next lowest mean composite score of 119.93 (School X). The highest scoring schools were V (mean composite score = 151.21), B (mean composite score = 137.02), and AA (mean composite score = 136.73). A matrix was developed to compare and contrast school properties, teaching strategies, and student demographics of the top performing and bottom performing schools (based on composite environmental literacy scores) in an effort to identify unique characteristics or sets of characteristics of each that collectively might help explain the gap in the environmental literacy scores.

Table 4.25 (Page 112) depicts the mean and ranges for each of the environmental literacy domain measures and the composite environmental literacy scores across the 3 highest and 3 lowest performing schools. The percentage of students at each school scoring above the average for the Arkansas students is also shown. Finally, the percentage of students scoring above the average environmental literacy composite scores for the national survey is shown. The highest achieving school, School V, scored 44.76 points higher on the composite environmental literacy scores than the lowest scoring school (School S). Seventy-three percent of the students that took the survey at School V scored above the average national composite environmental literacy score while none of the students scored above the average at School S. Further, 77% of the students at School V scored higher than the average Arkansas environmental literacy composite score (128.58). Only two students at School S scored above the average Arkansas environmental literacy composite score. A large gap exists in the scores for the individual domains and the composite environmental literacy scores between the highest performing school and the lowest performing school.

Table 4.26 (Page 113) is designed to show, in matrix form, school attributes, teacher attributes, and student attributes for the three top performing schools and the lowest three performing schools. In matrix form, the attributes were easily compared to find commonalities or differences between the two groups. The only commonality within the school attributes was high benchmark literacy scores (70-98 % proficient or above) and high science benchmark scores (86-90% proficient or above). None of the three schools had an outdoor classroom or community garden. Only one of the schools used an environmental education curriculum, Project Wild, as well as being part of the local Stream Team (a volunteer stream monitoring program based on citizen science) program. The top performing schools were fairly evenly split between gender, with each school having slightly more than 50% male and slightly less than 50% female. The ethnic make-up of the top performing schools differed from the lowest performing schools. The high performing schools were 88.5%, 72.4%, and 90.1% white for Schools V, AA, and B, respectively. By contrast, the lowest performing schools were 85.7%, 81.3%, and 57.5% black for Schools S, O, and T, respectively. The gap in scores between the white students and the black students was significant. All three of the lowest performing schools were located in the Delta Region. The Delta region was statistically significantly lower in composite environmental literacy scores than each of the five other regions of the state. These schools were also among the highest percentage free and reduced lunch.

The three teachers with the highest student composite environmental literacy scores and the three teachers with the lowest student environmental literacy scores were compared in a similar manner as the school comparisons. The lowest three teachers were the sole science teachers at their respective schools with students scoring the lowest composite environmental literacy scores on the MSELS. However, the teachers whose students, on average, scored the highest were not all from the three schools with the highest composite environmental literacy scores. The sole science teacher at School V was also the number one teacher in terms of students' scores on the MSELS. The other two teachers, however, were from schools not in the top three performing (on the MSELS) schools and teach at schools with more than one science teacher. This allowed a review of the teacher attributes while holding the school and student attributes constant. Table 4.27 shows the students' average scores for each of the environmental literacy domains as well as the average composite environmental literacy scores by teacher, Teachers In4 and Pcc1, as compared to the other science teachers at their respective schools, Schools I and P. The students who had Teacher N for science scored 7.36 to 16.18 points higher on the overall composite environmental literacy score than students who had one of the other four science teachers at the school. Likewise, students who had Teacher CC for science scored 17.71 to 22.04 points higher than students who had one of the other three science teachers.

Table 4.27.

Average Domain and Composite Scores by Teacher at Schools I and CC, Respectively

Teacher Code	Knowledge	Affect	Cognitive Skills	Behavior	Composite Score
In4	**45.35**	**41.64**	**18.38**	**37.55**	**142.92**
Ik1	43.86	37.65	15.16	33.04	129.72
Il2	42.62	38.12	11.96	34.04	126.74
Im3	43.50	39.02	19.58	33.47	135.56
I05	38.75	39.40	16.14	34.53	129.42
Pcc1	**46.21**	**41.24**	**21.33**	**37.24**	**146.02**
Pdd2	39.02	40.26	11.50	33.28	124.06
Pee3	39.07	40.88	14.0	34.36	128.31
Pff4	37.69	40.39	12.52	33.32	123.98

Data were reviewed to see if there were clear differences between the teaching settings, teaching strategies/methods, and/or assessments used by the teachers at the same school. At School I, Teacher In4 used more teaching settings based on the self-reported data including the use of school grounds which was also a common factor of the teacher at the top performing schools. While there was no dedicated outdoor classroom of garden space at his school, this teacher did report also making use of classrooms, labs, and the school library. His self-reported teaching strategies included lectures, discussions, and hands-on activities. The teacher who had the second highest scores did not use the school grounds or labs as a teaching setting. However, he did use inquiry-based teaching as a teaching strategy and was the only teacher at School I who reported doing so. The second teacher, Teacher Pcc1, was compared to her colleagues at School P. Teacher Pcc1 reported using several teaching settings with her students, including classrooms, computer labs, school grounds, library, and field trips. The school at which she teaches had an outdoor classroom that was used throughout the year. Her colleague, Teacher Pee3, also reported using several of the teaching settings, including the school grounds. Teacher Pcc1 also reported having attended five environmental education workshops/trainings over the years. The other teachers did not report any environmental education coursework or training. It should also be noted the 6th graders attend a science day camp as well as a science-related field trip during the school year.

The bottom three teachers all teach at the three lowest performing schools. The teachers, Teachers Sii1, Obb1, Tjj1, reported using classrooms, labs, and computer labs as teaching settings. Teaching strategies/methods identified by these teachers included lecture, hands-on, cooperative learning, and projects. One teacher, Sii1, did not return the Teacher Survey for evaluation, despite numerous requests to have it completed. School O reportedly takes students on a field trip to a museum annually while School T takes an annual field trip to a science center. No indication was provided that these field trips are related to environmental education. None of the three teachers at the lowest performing schools reported using school grounds as a teaching setting for their students.

The comparisons used to answer this research question indicate that the use of school grounds, with or without an outdoor classroom or garden area, may have a positive impact on the students' connection to the outdoors and, ultimately levels of environmental literacy. Students, in general, performed better on the MSELS when the teacher reported using school grounds as a setting for teaching. Additional research is needed in this area.

Table 4.25.

Descriptive Statistics for a Comparison of the Three Highest Performing Schools and Three Lowest Performing Schools by Students on the Environmental Literacy Survey

School Code		Domains of Environmental Literacy				
		Knowledge	Affect	Cognitive Skills	Behavior	Composite Score
School V	Mean	**47.23***	**43.90**	**27.96**	**38.12**	**151.21**
	Range	14.12 – 59.99	24.92 – 54.12	2 – 42	13 – 50	111.39 – 191.89
	% Students Above AR Average	88	76.9	73.1	73.1	76.9
	% Students Above Nat'l Average	--	--	--	--	73.1
School AA	Mean	41.56	40.58	20.0	34.59	136.73
	Range	14.12 – 59.99	21.31 – 55.15	0 – 45	16 – 57	85.74 – 207.37
	% Students Above AR Average	71.1	52.6	64.5	46.1	63.2
	% Students Above Nat'l Average	--	--	--	--	43.4
School B	Mean	40.56	42.76	16.0	37.70	137.02
	Range	17.65 – 59.99	29.15 – 55.23	0 – 42	19 – 59	90.06 – 179.12
	% Students Above AR Average	66.2	64.8	50.7	63.3	57.7
	% Students Above Nat'l Average	--	--	--	--	38.0
School S	Mean	25.87	37.29	8.14	34.5	106.45
	Range	3.53 - 45.88	23.04 – 54.31	0 – 20	17 – 52	83.86 – 141.54
	% Students Above AR Average	23.8	35.0	20.0	45.0	40.0
	% Students Above Nat'l Average	--	--	--	--	0
School O	Mean	26.30	37.66	11.38	35.22	111.28
	Range	3.53 – 56.46	21.69 – 50.34	0 – 30	12 – 52	60.43 – 165.64
	% Students Above AR Average	20.3	28.3	32.8	52.3	13.3
	% Students Above Nat'l Average	--	--	--	--	6.7
School T	Mean	26.01	38.18	9.79	37.90	111.88
	Range	3.53 – 56.46	19.85 – 55.18	0 – 33	12 – 56	62.55 – 162.09
	% Students Above AR Average	18.1	36.9	21.9	63.3	21.3
	% Students Above Nat'l Average	--	--	--	--	5.8

*Bold numbers are the highest reported scores

Table 4.26.

Matrix for Comparing the Three Highest Performing Schools and Three Lowest Performing Schools Based on School, Teacher, and Student Attributes

Attributes		School V	School AA	School B	School S	School O	School T
School	Region	3	4	2	4	4	4
	SES (%)	59.8	99.46	60.30	97.78	88.98	60
	Enrollment (# students)	27 (26)	82 (76)	72 (71)	30 (21)	77 (64)	126 (105)
	Locale	2	8	2	3	5	7
	Outdoor Classroom	No	No	No	No	No	No
	Benchmark Literacy (%)	96	98	70	70	82	82
	Benchmark Science (%)	90	87	86	33	55	44
	EE Programs	None	None	Project wild	None	None	None
Teacher	Total Years Teaching	18	8	3	---	1 (not certif.)	7
	Gender	F	F	F	F	F	F
	Highest Degree	Bachelor's	Master's	Bachelor's	---	Masters	Bachelors
	Age (Years)	51 – 60	31 – 40	41 – 50	41-50	21 – 30	31 – 40
	# EE Courses	0	0	1	---	1	0
	# EE Workshops	0	0	1	---	0	0
	Ethnicity	White	Black	White	Black	Black	White
	EE imp. to students	4	5	5	---	5	4
	EE imp. to self	4	4	5	---	5	3
	Env. Sensitivity	4	4	5	---	4	3
	Env. Behavior	14 (low)	26 (high)	25 (high)	---	18 (moderate)	23 (moderate)
Student	Ethnicity (%)						
	Am. Indian	3.8	1.3	8.5	---	10.9	7.7
	Hispanic	3.8	2.6	---	4.8	1.6	3.8
	Asian	---	1.3	---	---	3.1	4.8
	Black	3.8	18.4	1.4	85.7	81.3	57.5
	White	88.5	72.4	90.1	9.5	3.1	44.2
	Biracial	---	3.9	---	---	---	9.8
	Gender (%)						
	Male	61.5	50.0	57.7	52.1	53.1	48.6
	Female	38.5	48.7	42.3	47.6	46.9	50.5

Chapter V Conclusion and Discussion

Introduction

The results of this research add new information regarding the environmental literacy of 6th grade students in Arkansas. A national assessment, the National Environmental Literacy Assessment Project (NELA), was published in 2008 and measured the environmental literacy of 6th grade and 8th grade students across the United States. This research was the first state level assessment of environmental literacy conducted in the U. S. The data provided the opportunity to better understand the strengths and weaknesses of the Arkansas 6th grade students in the environmental literacy domains of ecological knowledge, affective disposition (attitudes), cognitive skills, and behavior (participation). The study established a baseline for Arkansas students against which future assessments can be compared, compared the findings to the national baseline data, and determined which variables significantly affected the students' environmental literacy.

Summary of Study

Students in 6th grade classes across Arkansas were surveyed to determine their levels of environmental literacy based on four domains – knowledge, affect, cognitive skills, and behavior as well as the overall composite level of environmental literacy. A total of 3,446 sixth grade students at 40 randomly selected schools were surveyed using the Middle School Environmental Literacy Survey (MSELS) instrument designed by McBeth et al. (2008).

An ex post facto research design was used to analyze the random sample. The MSELS instrument was administered to the students during regular school hours. Students were surveyed during April and May 2013 by the researcher or by individuals trained by the researcher. A protocol was developed to ensure that the method by which the data were collected was consistent across schools. Data were analyzed using descriptive and inferential statistics including frequencies, means, standard deviations, t-tests, Pearson product moment correlation, ANOVA, and Bonferonni post hoc tests.

Conclusions by Research Question

Research question 1.

The 6th grade students in Arkansas scored higher on the ecological foundations or knowledge component of the environmental literacy survey than they did on the issue identification, issue analysis, and action planning components. However, the majority of the students had difficulty correctly answering questions related to nutrient cycling and energy transfer in ecological foundations, content covered by the Arkansas Frameworks in K-5 or grade 6. The aggregate mean for Arkansas students on the ecological foundations part of the MSELS was 61.8%. By contrast, the students scored significantly lower on the issue identification, issue analysis and action planning sections averaging 27.3, 35.3, and 33.8%, respectively. Less than one third of the students were able to identify environmental issues in three short reading passages about specific environmental problems. Slightly over one third were able to analyze the environmental issue and identify the values (environmental, legal, social, ethnocentric, and economic) represented by key stakeholders involved. Additionally, approximately one-third of the students were able to identify appropriate action strategies to prevent the potential environmental issue.

The affective or personal dispositions parts of the MSELS indicated the students do generally have a high affinity for the environment. Differences in the scores for intent to act on behalf of the environment and self-reported behavior indicate the students have a greater intent to act than actual reported action. Anecdotally, several students verbalized they are limited in their ability to act. For instance, students at one southwest Arkansas school discussed their inability to recycle because there was no community recycling program available to them. Students at several schools commented their parents do not recycle and so they cannot either. These limitations on students taking action can skew the interpretations made when comparing the intention to act with the actual self-reported behavior. In terms of environment sensitivity or having positive feelings toward the environment, the students varied widely in their responses (SD=7.43). Thirty-six percent rated their extent of environmental sensitivity as higher than moderate while 38.6% reported only a moderate extent. These findings indicate a significant number of students do not feel connected to their environment.

The scores of the Arkansas 6^{th} grade students on each individual component of the MSELS were compared to the results of the national study. Independent t-tests revealed the Arkansas students scored significantly lower than the national students on ecological foundations, issue analysis, action planning, and intention to act and self-reported behavior. We can infer from these findings that 6^{th} grade students in Arkansas are falling behind the students nationwide in environmental literacy.

Research Question 2.

The mean composite level of environmental literacy was 128.58 (out of 240) for the Arkansas students. The range in environmental literacy was divided into three levels (as used in the national study), low (24-96), moderate (97-168), and high (169-240). The Arkansas score falls in the moderate range of environmental literacy. The mean composite score for the national sample was 143.99, also falling in the moderate range of environmental literacy. These results support the findings of research question 1 that the 6^{th} grade students in Arkansas are falling behind the nation in terms of composite environmental literacy. However, we can also infer that 6^{th} grade students nationwide lack a high level of environmental literacy. Particularly lacking are the high level thinking skills that enable students to identify issues, analyze issues, and solve problems. Yet, these are exactly the skills required to analyze and solve the complex environmental problems facing the world today and in the future.

Research Question 3.

The findings of this study indicate that few of the school-level variables were correlated to environmental literacy. Sixth grade enrollment, locale (rural vs. urban), and school configuration (elementary schools vs. middle schools) were not significant. Students in the Delta physiographic region scored significantly lower than the other five physiographic regions of the state. The Delta region is economically depressed with high poverty levels and high rates of unemployment. These schools serve underrepresented students. Resources and opportunities are limited for these students. A significant negative correlation was found between SES (based on percentage free and reduced lunch) and the ecological knowledge component. Significant positive correlations were found between science benchmark scores (school-level) and ecological knowledge, cognitive skills, and composite environmental literacy scores. The same was found with respect to literacy benchmark scores.

Research Question 4.

The 6^{th} grade science teachers completed a survey that included demographic information, questions about classroom teaching strategies, and Likert-scale questions about their personal beliefs about environmental education and the environment. Based on the data analyzed from these surveys, the teacher-level variables did not significantly impact students' environmental literacy. Despite these findings, it is likely the teachers play a key role in integrating environmental education in the classroom. The next phase of this study will involve one-on-one interviews with the science teachers at the three schools with the highest student performance on the MSELS. These interviews will, hopefully, clarify why the students at these particular schools exhibited a higher level of environmental literacy than those at the other schools.

Research Question 5.

Students who have higher levels of contact or engagement with the outdoors scored significantly higher on the knowledge component, affective component, and the behavior component. Research indicates that support from parents and families increases learning and retention of environmental concepts when experienced in outdoor settings (Fettes & Judson, 2011). Further, positive experiences in the outdoors with adult role models leads to environmental activism in adulthood (Chawla, 1999). The students in this study who engaged in outdoor activities with families or youth leaders did, indeed, score higher in environmental literacy than those who did not. For those students whose families do not make outdoor activities a part of family life, schools must provide the students with opportunities for learning in the outdoors. Not only are the connections with the environment key, but science achievement increases in schools with outdoor experiences as a part of the regular curriculum (Connors & Perkins, 2009). Problem solving skills and critical thinking skills can be enhanced through outdoor experiences.

Research Question 6.

A comparison of the school, teacher, and student attributes of the top three performing schools and the lowest three performing schools on the MSELS were compared. Differences were noted in teacher preparation and on-going professional development in environmental education. The most revealing finding is that all three of the lowest scoring schools are located in the Delta region. A follow-up study with the science teachers at the three highest performing schools should uncover additional explanations for these findings.

Discussion

Overarching Goal of Environmental Education.

The term *environmental education* has been used since the 1960s. In 1996, the U.S. EPA Office of Environmental Education published the following definition:

> Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action. (Federal Register, Tuesday, December 10, 1996, p. 65106)

The overarching goal of environmental education is the creation of an environmentally literate citizenry (UNESCO, 1977). The detrimental effects of climate change, loss of biodiversity, food, clean water, fuel, and space continue to challenge society. By preparing people to understand and address these challenges and issues, environmental education creates the new behaviors that are the ultimate expression of environmental literacy. An environmentally literate citizenry is critical to finding workable, evidence-based solutions to slow or stop environmental degradation.

An environmentally literate person, according to *Developing a Framework for Assessing Environmental Literacy* (Hollweg et al., 2011), is "someone who, both individually and together with others, makes informed decisions concerning the environment; is willing to act on these decisions to improve the well-being of other individuals, societies, and the global environment; and participates in civic life" (p. 2-3). Individuals who are environmentally literate possess the knowledge and understanding of a wide range of environmental concepts, problems, and issues; a set of cognitive and affective dispositions; a set of cognitive skills and abilities; and the appropriate behavioral strategies to make sound decisions.

It is difficult to evaluate existing environmental education programs and approaches, much less determine how to maximize their potential to advance environmental literacy, without a starting point. In order to evaluate the efficacy of environmental education in the U.S., assessments of environmental literacy are necessary. However, such assessments have only recently been developed. In 2008, McBeth et al. published the first national baseline study of environmental literacy focusing on all four components or domains of environmental literacy – ecological knowledge, environmental affect, cognitive skills, and behavior. The instrument used for this nationwide study was the Middle School Environmental Literacy Survey (MSELS). Using the MSELS, this research explored the current state of environmental literacy in 6th grade students throughout Arkansas.

Status of Environmental Literacy in Arkansas

Eight parts of the MSELS were scored separately, then appropriately combined to correspond to the four components or domains of environmental literacy. These distinct parts were also combined into a single composite environmental literacy score for students, schools, and statewide.

Students averaged a score of 10.52 out of a possible 17 on the ecological foundations (Part II). When converted into the combined component mean, the sample mean (37.12 out of a possible 60) was within the categorical range of moderate. The national sample scored a mean of 11.24 with a composite mean of 39.67 which was also within the moderate range. Students in Arkansas answered about 62% of the questions correctly while the national students answered about 66% of the questions correctly. Students from both the national study and this study showed a stronger ability to answer questions lower on Bloom's Taxonomy. For example, Item 6 dealt with food chains but was worded as a definitional question which ranks low on Bloom's Taxonomy. Ninety–three percent of the Arkansas students answered this item correctly and 92% of the students in the national study answered it correctly. These findings emphasize that both sets of students memorized isolated facts well but could not transfer learning to higher levels of Bloom's Taxonomy wherein those isolated facts are used to understand bigger concepts, solve problems, or think critically.

From these findings one can infer the students have only a nominal level of environmental literacy as defined by Roth (1992). They are able to recognize many of the basic ecological terms used in communicating about the environment and have basic knowledge of how natural systems work. Based on the questions most frequently missed, the 6^{th} grade students in Arkansas have not yet reached what Roth defined as a functional level of ecological knowledge which would require a higher level of knowledge and understanding of how natural systems interrelate.

Verbal commitment or intent to act (Part III) indicated the students have developed a commitment or intention to act positively toward the environment, though still only to a moderate degree. The mean for the Arkansas students was 42.08 (out of a possible 60) while the mean for the national sample was 43.89. In terms of environmental sensitivity (Part V) there was little difference between the Arkansas students and the national sample. Means were 32.54 (out of a possible 55) and 32.47 for the Arkansas and national students, respectively. Students expressed positive feelings toward the environment with both samples scoring higher than 8 out of 10 on Part VI. These three individual parts (III, V, and IV) were combined to represent the environmental affect domain of environmental literacy. Combined scores were 40.16 out of 60 for the Arkansas students and 40.73 for the national students, both falling within the moderate range. These findings suggested the students are developing an awareness and sensitivity toward the environment but have not yet become fully aware of the need to appreciate and care for the environment. The students seemed to possess a nominal level as defined by Roth (1992) of environmental literacy in terms of the disposition domain.

Arkansas students did not perform well on the cognitive skills domain. Most students were unable to identify environmental issues (Part VII.A) after reading a short passage. Means for the Arkansas students and national students were 0.82 and 1.31 out of 38, respectively.

Part VII.B, issue analysis, required students to analyze the environmental situations and evaluate the personal values and ethics of the key players in the passages. Means for issue analysis were 2.12 and 2.75 for the Arkansas and national students, respectively. A key component of the cognitive skills domain as used within the context of environmental literacy is the ability to consider all of the evidence put forth and then to choose an appropriate course of action to help resolve the issue. Students were largely unable to identify the correct action strategy, with means of 6.76 and 6.97 for the Arkansas and national samples, respectively. The combined component means for the cognitive skills domain were 14.96 for the Arkansas 6th grade students and 25.15 for the national students. Both of these means fell within the low environmental literacy range. Students were functioning at a nominal level of environmental literacy as defined by Roth (1992). They showed little ability to analyze, synthesize, and evaluate information about environmental problems or issues and were unable to select appropriate action strategies related to citizen participation.

Environmentally responsible behavior requires students to act in meaningful ways to solve problems and resolve issues. Part IV evaluated students' sense of personal responsibility to act through persuasion, consumer action, eco-management, and political or legal action. Students reported a moderate level (as identified in the NELA report) of environmentally responsible behavior. Means were 35.95 and 32.54 out of 60 for the Arkansas and national samples, respectively. Effective environmental education programs are needed to instill a greater sense of environmental stewardship in the youth. Students must be taught that stewardship is not an individual activity; they must participate in a larger discourse to take action.

Overall environmental literacy was represented by a composite score that combined the four domains, adjusted so that each represented an equal part of the composite score. Arkansas 6^{th} grade students scored an average of 128.58 out of a possible 240. This represented 53.6% of the total possible and placed the score slightly below the middle of the moderate range (97-168) of environmental literacy. The national baseline mean was 143.99 or 60% of the total possible and placed the score at the high end of moderate environmental literacy. These findings indicate the 6^{th} grade students in Arkansas are behind the students sampled nationally. Environmental education in Arkansas must become a vital part of the curriculum if we are to advance the environmental literacy to create a citizenry capable of solving the complex environmental problems today and in the future.

Both assessments indicated environmental education is failing in the U.S. and in Arkansas. However, the Arkansas students lag behind the nation. Students are not being taught the critical thinking skills necessary for understanding the complex environmental issues facing the world today. They do not demonstrate the ability to analyze and synthesize information to solve problems. Additionally, they do not have a strong sense of individual responsibility or the inclination to engage within the community in appropriate ways. Environmental educators and perhaps even educators as a whole must do more to improve environmental literacy on a statewide and national basis.

Recommendations for Advancing Environmental Literacy

Arkansas has an array of natural resources that serve a vibrant tourism industry and have created cultural diversity and heritage across the state. Known as the "natural state," Arkansas is the home to 38 State Parks, one State Forest, 19 State Wildlife Management Areas, one State Historic Site, one State Natural Area, three State Fish Hatcheries, one National Park, one National Memorial, four National Forests, one National Historic Site, and nine National Wildlife Refuges. Sustaining these precious resources for generations to come requires the youth of Arkansas to be engaged in the environment and prepared to protect their legacy through active stewardship. This will be difficult to accomplish if youth remain largely disconnected from the natural environment. One place for change to occur is within the educational system in order to arm the students with the skills and knowledge necessary to address the complex environmental issues of today and in the future. Graduating students with a nominal level of environmental literacy cannot be acceptable to educators. A functional level of environmental literacy is desirable.

The State and Environmental Literacy

Developing a state environmental literacy plan would be a recommended key component in advancing environmental literacy in children and adolescents. An environmental literacy plans provides a framework to support the integration of environmental education and environmental literacy into the required curriculum as well as providing support to schools and teachers who are using the environment to engage students in learning. State environmental literacy plans help ensure graduates are globally competitive in the 21st century and prepared to work toward a sustainable future. The environmentally based learning required by most environmental literacy plans encourages critical-thinking skills, engages students in hands-on, inquiry-based learning and encourages healthy, active lifestyles while fostering environmental literacy and civic responsibility. Many states have already developed environmental literacy plans to guide environmental education on a statewide level. Arkansas was in the process of doing so, but stopped once No Child Left Inside failed to pass in Congress.

The findings of this study provide a baseline level of environmental literacy of 6th grade students that can help guide educators as they continue to develop an environmental literacy plan for Arkansas. Such a plan would serve as a master plan for environmental education in the state.

Schools and Environmental Literacy

Based on personal observation, a disparity in resources exists within the schools around the state. The schools in many of the rural areas of the Delta region were old, unkempt, and devoid of many of the resources (iPad carts, animals in the classroom, models) observed in other classrooms throughout Arkansas. The Arkansas Delta is an economically impoverished region of the state. The results of this study indicated students in the Delta region had the lowest mean scores for knowledge, affect, and cognitive skills as well as for composite environmental literacy scores. Two of the three lowest performing schools on the environmental literacy survey were situated in the Delta region. No statistical significance was found for the independent variables of 6th grade class size, school locale, type of school (elementary versus middle school), or organization of the teachers (self-contained teaching, departmentalized teaching, and cross-disciplinary team teaching). However, there was a negative correlation between SES and environmental literacy.

The lack of significance in most of the school variables was positive as the school attributes are not easily changed. Improving curriculum and teacher development are easier to change than poverty, school configuration, or locale. However, special attention must be given to improving the environmental literacy of the students in the Delta region. Efforts to integrate environmental education into the curriculum, create outdoor classrooms and/or community gardens that are widely used for instruction, and develop environmentally responsible behavior are needed to improve the overall environmental literacy of the students in this region.

Teachers and Environmental Literacy

Arkansas teachers surveyed in this study believed there was a strong need to expose students in K-12 to environmental education. Teachers surveyed during the national study had a similar response. Teachers from both studies also felt environmental education was important to them, but when the teachers were asked about their training in environmental education, a problem became apparent. Of the 58 teachers surveyed, 47 teachers (81%) self-reported they had never taken any type of environmental education course during their teacher preparation programs. Teachers need training to effectively use the environment as a context for teaching. Training must be in both content and pedagogical strategies. In-service teachers in Arkansas have access to training in a number of supplemental national environmental education project materials such as Project Learning Tree, Project WET, Project WILD, and GLOBE. Additional summer workshops and professional development trainings are available at state and district levels. The Arkansas Environmental Education Association provides summer training and a biennial expo to train teachers to integrate environmental education into their curriculum. Yet 60% of the science teachers surveyed reported they had never taken any environmental education workshops or other professional development that related to environmental education during their teaching career. Only three teachers reported they had attended Project WILD training, two Project WET training, and one had attended GLOBE training. These three teachers reported they rarely incorporate any of the materials/activities into their lessons and none of them use the respective environmental education curriculum completely. Teachers in Arkansas are required to complete a minimum of 60 hours of professional development per year. Many teachers will not participate in professional development opportunities if the program does not count toward their 60 hours. In low performing schools, often the professional development must focus on Common Core English/Language Arts standards. Funding needs to be secured to encourage teachers to attend professional development trainings related to environmental education and using the natural environment as an extension of the classroom as well as connecting to Common Core Mathematics and ELA standards. Teachers will be more willing to participate if they can see the training is relevant to benchmark assessments.

Pre-service teacher education programs are filled with general and professional education courses with little room for the addition of any environmental education courses. As a result, few universities have any type of required environmental education coursework or fieldwork. To effectively improve environmental education in Arkansas, pre-service science teachers (undergraduate college students) need to be taught how to incorporate environmental concepts in the classroom. They need content knowledge as well as the skills of how to teach the concepts (McDonald & Dominguez, 2010). The concepts and ideas of environmental education are intended to be interdisciplinary and supplemental in K-12 curriculum, not a discrete subject area. Pre-service teachers need to be taught the content and pedagogical knowledge to facilitate integration of environmental education within the curriculum framework. Environmental education can be used as a way to promote environmental literacy for pre-service teachers as well as teaching them an interdisciplinary approach to teaching. Teachers need opportunities during their college programs to practice instructional strategies for environmental education such as hands-on observation and discovery of the environment, inquiry, cooperative learning, service learning, and problem-based learning.

When environmental education is included in teacher preparation programs, it is most often in the social studies and/or science methods courses (Plevyak et al., 2001). These methods courses should, then, model the methods for teaching environmental education. Though the entire course cannot be devoted to environmental education, integrating content and pedagogy into the lessons designed to model science methods would be a start. Ideally, teacher preparation programs would develop an environmental education methods course designed for pre-service science teachers to prepare them to teach environmental education both in their classrooms and in various outdoor and non-formal settings. Pre-service students should participate in inquiry-based settings that allow them to be learners. Teacher preparation programs should look to the Guidelines for the Preparation and Professional Development of Environmental Educators (NAAEE, 2010) and follow the recommendations about the basic knowledge and abilities educators need to effectively teach environmental education. The programs must also encourage teachers to develop their own “sensitivity” toward the environment and a willingness to act personally if they are to be effective environmental educators. With proper training at the program level, teachers will be better equipped with resources, skills, and knowledge to help them integrate environmental education into the science classroom.

Without placing an emphasis on or at least creating an awareness of the importance of environmental education, pre-service teachers will become in-service teachers who teach to the standards and fail to incorporate environmental education into their lessons. If the quality of preparation to teach environmental concepts does not increase, we cannot advance the environmental literacy of the students. Teachers must have the opportunity to improve their environmental content knowledge, skills in teaching about the environment, and pedagogical skills for teaching outdoors.

Integrating Environmental Education in the Curriculum

Fifteen schools in this study reported they have an outdoor classroom or community garden area for outdoor instruction. Only one school reported that they use the space throughout the year; the others never use it or use it only once or twice during the year. In all cases, when the outdoor space is used, it is for science class. No interdisciplinary uses were identified. Using the school grounds as a part of curriculum is one way to integrate environmental education into the curriculum.

To be effective, environmental education needs to be integrated throughout the K-12 curriculum. Environmental education must be integrated across core subject areas, not just taught in the science classes. Students need to have interrelated and sustained opportunities to participate in outdoor learning experiences and classroom experiences that increase their environmental awareness and content knowledge.

One effective method is to integrate content from proven environmental education curricular materials such as Project WET, Project WILD, and Project Learning Tree. Other ways to increase environmental literacy through instruction include providing outdoor field and service-learning experiences for the students, more outdoor education using the school grounds, outdoor classrooms or community gardens, and guest speakers from the community who are knowledgeable about the environment (park rangers, Audubon Society, Master Naturalists, and other environmental groups). Schools can also provide opportunities for students to participate in extracurricular service-oriented environmental clubs. The use of science fairs, Envirothons, and Science Olympiads provide outstanding opportunities for students to engage in environmental education. Carefully planned field trips are invaluable for connecting students to nature. Students learn in non-formal settings such as zoos, aquaria, and museums. Day and/or resident trips to science centers or environmental centers can have a long-lasting impact on students' connection to the environment. Money and time are common barriers to including outdoor experiences off school grounds for instructional purposes. If we are to advance environmental literacy in Arkansas, the instructional focus has to shift. Environmental education must become a part of the curriculum in an integrated and interdisciplinary fashion. Students must "experience" the environment outdoors as well as studying environmental issues in the classroom if they are going to develop a sensitivity and appreciation for it. Connecting the students to nature is key to improving environmental literacy. The use of outdoor spaces for instruction increases environmental literacy and should be advocated by the schools. For this to be an effective instructional strategy, teachers must be properly trained to effectively teach outdoors and to connect these settings to the Common Core standards.

Recommendations for Further Research.

This research effort focused on assessing the environmental literacy of 6th grade students; providing information on the status of environmental literacy of 6th grade students in Arkansas. The NELA project assessed both 6th and 8th grade students and compared the findings of 6th graders to those of 8th graders. There have not been any studies conducted where the students are tracked over a number of years to document how their environmental literacy develops with age. The Arkansas assessment should be expanded in two years with a longitudinal re-assessment of the 6th grade cohort as 8th graders. Not only could those results be compared to the national baseline data, but the results would provide the first statewide longitudinal study of environmental literacy. The results would quantify what changes have occurred in the environmental literacy of students as they mature academically, physically, and developmentally. As schools incorporate environmental education into their curriculum, the efficacy of the changes could be tracked as a result of a longitudinal study.

A qualitative follow-up study could be conducted looking at and evaluating the top performing schools in this study to find out why and how their students performed so well on the environmental literacy survey. This follow-up could then be expanded to identify schools with overarching environmental education themes and curricula and compare the environmental literacy of those students to the newly established baseline data. Included in this cohort would be schools with outdoor classrooms that use them on a regular basis and connect the outdoor context to the classroom. Comparing schools with environmental programs and interdisciplinary environmental efforts to those without may provide researchers with additional data from which to develop new environmental education curricula and programs.

Because teachers in this study indicated they had not received environmental education training as pre-service teachers (students), further research should be conducted to survey college and university teacher education preparation programs to determine the extent to which environmental education is incorporated into the teacher preparation programs in Arkansas and nationwide. A similar study should be conducted for in-service professional development opportunities. Additional research with the teachers from this study would provide insight into why, despite the availability of professional development opportunities, the teachers have not taken part in the training opportunities.

The impact of professional development in environmental education provides another avenue for further research. Teachers could be studied as they participate in environmental education professional development opportunities. Is the professional development effective? What are the longitudinal effects on the teachers? Do they take what they have learned back to their schools and integrate it into their lessons? Or does it simply fulfill part of the 60 hour requirement? What outside influences affect whether or not teachers implement teaching strategies learned during the environmental education professional development once they are back in their schools/classrooms?

References

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York, NY: Oxford University Press.

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., Wittrock, M. C. (2000). *A Taxonomy for Learning, Teaching, and Assessing: A revision of Bloom's Taxonomy of Educational Objectives*. New York: Pearson, Allyn & Bacon.

Arkansas Department of Education (2005a). *K-8 science curriculum framework*. Retrieved from http://arkansased.org/educators/doc/science_k_8_011006.

Arkansas Department of Education (2005b). *Environmental science science curriculum framework*. Retrieved from http://arkansased.org/educators/pdf/environment9_12_06.pdf.

Brice, R. A. (1973). A procedural model for developing environmental education programs for young teachers. (Doctoral dissertation, University of Georgia, 1972). Available at Dissertation Abstracts International: Section A. Social Sciences and Education, 34:4052.

Carson, R. (1962). *Silent spring*. Boston, MA: Houghton Mifflin.

Carter, R. L., & Simmons, B. (2010). The history and philosophy of environmental education. In A. M. Bodzin; B. Shiner Klein & S. Weaver (Eds.), *The inclusion of environmental education in science teacher education* (1st ed., pp. 3-16). New York, NY: Springer.

Chalufour, I. & Worth, K. (2003). *Discovering nature with young children*. St. Paul, MN: Redleaf Press.

Chawla, L. (1999). Life paths into effective environmental action, *Journal of Environmental Education, 31*(1), 15-26.

Comstock, A. B. (1911). *Handbook of nature study*. New York, NY: Cornell University Press.

Comstock, A. B., & Gordon, E. L. (1939). *Handbook of nature-study*. Ithaca, NY: Comstock Pub. Co.

Conley, D. T. (1993). *Roadmap to restructuring: Policies, practices and the emerging visions of school*. Eugene, OR: ERIC Clearinghouse on Educational Management.

Connors, M. M. & Perkins, B. (2009). The nature of science education. *Democracy and Science, 18*(3), 56-60.

Cook, S. & Berrenberg, J. L. (1981). Approaches to encouraging conservation behavior: A review and conceptual framework. *Journal of Social Issues, 37*(2), 73-107.

Cortes, L. (1987). A survey of the environmental knowledge, comprehension, responsibility, and interest of the secondary level students and teachers in the Phillippines. (Doctoral dissertation, Michigan State University, 1986). Available in Dissertation Abstracts International: Section A. Social Sciences and Education, *47*(7), 2529.

Coyle, K. (2005). *Environmental literacy in America*. Washington, DC: National Environmental Education Foundation.

Culen, G. R. (ND). The status of environmental education with respect to the goal of responsible citizenship behavior. In Hungerford, H. R., Bluhm, W. J., Volk, T. L., & Ramsey, J. M. (2005). *Essential Readings in Environmental Education (3rd edition)*. Champaign, IL: Stipes Publishing.

Cunningham, W. P. & Cunningham, M. A. (2012). *Environmental science, A global concern* (12th ed.). New York, NY: McGraw Hill.

Dewey, J. (1900). *School and Society* (2nd ed.). Chicago: The University of Chicago Press.

Disinger, J. (2001). Environmental education's definitional problem. In H. R. Hungerford, W. J. Bluhm, T. L. Volk, and J. M. Ramsey (Eds.), *Essential Readings in Environmental Education* (2nd ed., pp. 17-31). Champaign, IL: Stipes Publishing.

Disinger, J. F. (1993). Environmental Education in the K-12 Curriculum: An Overview. In Wilke, R. (Ed.), *Environmental Education Teacher Resource Handbook*. Milwood, NY: Kraus International Publications.

Disinger, J. F. (1985). What research says. *School Science and Mathematics*, 85(1), 59-68.

Disinger, J. F. (1983). *Environmental education's definitional problem*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Ehrlich, Paul R. (1968). *The population bomb*. New York: Sierra Club/Ballantine Books.

Environmental Education Act. (1970). P.L. No. 91-516, 84 Stat. 1312.

Erdogan, M., Kostova, Z., & Marcinkowski, T. (2009). Components of environmental literacy in elementary science education curriculum in Bulgaria and Turkey. *Eurasia Journal of Mathematics, Science, and Technology Education, 5(1), 15-26*.

Fettes, M. & Judson, G. (2011). Imagination and the cognitive tools of place-making. *Journal of Environmental Education*, *42*(2), pp. 123-135.

Ford, P. (1986). *Outdoor education: Definition and philosophy*. Office of Educational Research and Improvement (ED), Washington DC.

Gibson, D. J. (1996). Textbook misconceptions: The climax concept of succession. *The American Biology Teacher, 58*(3), 135-140.

Gilbertson, K. L. (1990). Environmental literacy: Outdoor education and its effect on knowledge and attitude toward the environment. Ph.D. diss., The Ohio State University, Columbus, OH.

Gingrich, B. (1988). In *Trends and issues in environmental education: Environmental education in school curricula. Reports from a symposium and a survey*. J. Disinger, 303. Columbus, OH: ERIC/SMEAC and Troy, OH: NAEE. Eric document, ERIC 292 608.

Grant, T. & Littlejohn, G. (2005). *Teaching Green: The Elementary Years*. Gabriola Isaland, BC, Canada: New Society Publishers.

Green, S. B. & Salkind, N. J. (2011). *Using SPSS for windows and Macintosh: Analyzing and understanding data* (6^{th} ed.). Prentice Hall: Upper Saddle River, New Jersey.

Hammerman, D. R. (1978).*Historical background of outdoor education*. Taft Campus occasional paper no. 17. Rockford IL: Northern Illinois University.

Hammerman, D. R. (1980). *Fifty years of resident outdoor education, 1930-1980, Its impact on American education*. Martinsville, TN: American Camping Association.

Harde, R. B. (1984). Environmental studies: Towards a definition. In *Monographs in environmental education and environmental studies*. Vol. 1, Sacks, A. (ed.). pp. 31-34. Troy, OH: NAAEE.

Hart, P. (2007). Environmental Education. In Abell, S. K. &Lederman N. G. (eds.), *Research on science education* (pp. 689-726). New York, NY: Routledge, Taylor & Francis Group.

Helvarg, D. (1994). The War Against the Greens (San Francisco, California, Sierra Club).

H. R. 2547. (2011). No Child Left Inside Act: 1-25.

Hollweg, K. S., Taylor, J. R., Bybee, R. W., Marcinkowski, T. J. McBeth, W. C., & Zoido, P. (2011). *Developing a framework for assessing environmental literacy*. Washington, DC: NAAEE. Available at http://www.naaee.net.

Hungerford, H. R., Volk, T. L., McBeth, W. C., & Bluhm, W. J. (2009) *Middle School Environmental Literacy Survey*. Carbondale, IL: Center for Instruction, Staff Development, and Evaluation.

Hungerford, H. & Volk, T. (1990). Changing learner behavior through environmental education. *The Journal of Environmental Education, 21*(3), 8-22.

Hungerford, H. R., Peyton, R. B., & Wilke, R. J. (1981). Goals for curriculum development in environmental education. *Journal of Environmental Education, 11*(3), 42-47.

Hungerford, H. R. & Tomera, A. N. (1977). Science in the elementary school. Champaign, IL: Stipes Publishing Company.

Iozzi, L. A. (1988). The two faces of technology. In L. Iozzi & C. Shepard (Eds.) *Building multicultural webs through environmental education: Selected papers from the 17th annual conference of the North American Association for Environmental Education*. (pp. 14-19). Troy, OH: ERIC/SMEAC.

Iozzi, L. (Ed.). (1984). *A Summary of Research in Environmental Education. 1971-1982. The Second Report of the National Commission in Environmental Education Research*. (Monographs in Environmental Education and Environmental Studies, Vol. #2). Columbus, OH: ERIC/SMEAC.

IUCN. (1970). International working meeting on environmental education in the school curriculum: Final report. Gland, Switzerland: IUCN.

Jackman, W. S. (1891). *Nature-study for the common schools*. New York, NY: Henry Holt and Company.

Johnson, E. & Mappin, M. (2005). *Environmental education and advocacy: Changing perspectives of ecology and education*. New York, NY: Cambridge University Press.

Keene, M. & Blumstein, D. T. (2010). Environmental education: A time for change. Evaluation and program planning 33: 201-204. Doi: 10.1016/j.evalprogplan.2009.07.014.

Kline, B. (2007). *First along the river: A brief history of the U. S. environmental movement* (3rd ed.). Lanham, MD: Rowman & Littlefield.

Krutch, J. W. (1962). *Thoreau: Walden and other writings*. New York: Bantam Books.

Kuhlmeier, H., Van Den Bergh, H., & Lagerweij, N. (2005). Environmental knowledge, attitudes, and behavior in Dutch secondary education. *The Journal of Environmental education, 30*(2), 4-14.

Larkin, B. J. (1977). Environmental education: Beer cans and pet dinosaurs or the human habitat. In The report of the North American seminar on environmental education. J. Aldrich, A. Blackburn & G. Abel (Eds.). Columbus, OH: ERIC/SMEAC.

Leopold, A. (1949). *A sand county almanac and sketches here and there*. New York, NY: Oxford University Press.

Lieberman, G. A. & Hoody, L. L. (1998). Closing the achievement gap: Using the environment as an integrating context for learning. *State Education and Environmental Roundtable*. San Diego, CA

Louv, R. (2005). *Last Child in the Woods: Saving Our Children From Nature-Deficit Disorder*.Chapel Hill, NC: Algonquin Books.

Makki, M., Abd-El-Khalick, E., & Boujaoude, S. (2003). Lebanese secondary school students' environmental knowledge and attitudes. *Environmental Education Research*, 9(1), 21-33.

Marcinkowski, T. J. (1990). The new environmental education act: A renewal of commitment. *Journal of Environmental Education*. 22, no. 2 (Winter):7-10.

Marcinkowski, T. J., (2004). Using a logic model to review and analyze an environmental education program. In T. Volk (Ed.). *NAAEE monograph series, volume 1*. Washington, DC:NAAEE.

Marcinkowski, T., Shin, D., Noh, K., Negev, M., Sagy, G., Garb, Y., McBeth, W., Hungerford, H., Volk, T., Meyers, R., & Erdogan, M. (2011). National assessments of environmental literacy: A review, comparison, and analysis. In M. Brody, J. Dillon, R. Stevenson, and A. Wals (Eds*.). International handbook of research in environmental education*. Washington, DC: AERA and Abingdon, UK: Routledge.

Marsh, G. P. (1864). *Man and Nature*. Reprinted as The Earth as Modified by Human Action (Belknap Press, Cambridge, Massachusetts, 1965).

McBeth, B., Hungerford, H. R., Marcinkowski, T., Volk, T., & Meyers, R. (2008). *National environmental literacy assessment, year1: National baseline study of middle grades students, final research report*. Washington, DC: National Oceanic and Atmospheric.

McBeth, W. (1997). An historical description of the development of an instrument to assess the environmental literacy of middle school students. (Doctoral dissertation, Southern Illinois University at Carbondale, 1997). Available in Dissertation Abstracts International: Section A. Social Sciences and Education, 58(36), 2143.

McComas, W. F. (2003). The nature of the ideal environmental science curriculum: advocates, textbooks, & conclusions. Part II of II. *American Biology Teacher*, 65(3), 171-78.

McComas, W. F. (2008). Back to the Future? Reconsidering the role of 19th century nature-study in 21st century science teaching. *The Science Teacher, 75*(2), 24-28.

McDonald, J. T. & Dominguez, L. A. (2010). Professional preparation for science teachers in environmental education. In Bodzin et al. (eds.), *The Inclusion of Environmental Education in Science Teacher Education* (pp. 17-30). Doi: 10.1007/978-90-481-9222-9_2.

NAAEE. (2010). *Guidelines for the preparation and professional development of environmental educators*. Washington, DC: Author.

NAAEE. (2008). *Developing a state environmental literacy plan*. Washington, DC: Author

NAAEE. (2004a). *Environmental education materials: Guidelines for excellence*. Washington, DC: Author.

NAAEE. (2004b). *Environmental education materials: Guidelines for learning (K-12)*. Washington, DC: Author.

Nash, R. F. (1976). Logs, universities, and the environmental education compromise. In R. Marlett (ed.), *Current issues in environmental education II*, (pp. 10-18). Columbus, OH: ERIC/SMEAC.

National Council for Science and the Environment. (2008). *Environmental research and education needs: An agenda for a new administration*. Washington, DC: National Academy Press.

National Environmental Education Advisory Council. (2005). *Setting the standard, measuring results, and celebrating successes. A report to Congress on the status of environmental education in the United States.* Washington, DC: U. S. Environmental Protection Agency.

National Environmental Education Advisory Council. (2001). *Report to Congress II*. Washington, DC: U. S. Environmental Protection Agency.

National Environmental Policy Act of 1969, 42 U. S. C. § 4321 (2004).

National Research Council (NRC). (1996). National science education standards. Washington, DC: National Academies Press.

Negev, M., Sagy, G., Garb, Y., Salzberg, A., & Tal, A. (2008). Evaluating the environmental literacy of Israeli elementary and high school students. *The Journal of Environmental Education, 39*(2), 3-20.

Nelson, W., (1996). Environmental literacy and residential outdoor education programs. Unpublished doctoral dissertation, University of La Verne.

Nixon, R. (1970). President's message to the congress of the United States. In Environmental quality, the first annual report of the Council on Environmental Quality, together with the President's message to Congress. Washington, DC: U. S. Governmental Printing Office.

Person, J. L. (1989). *Environmental science*. Dallas, TX: J. M. LeBel Enterprises, Inc.

Pleyvak, L. & Mayfield, A. (2010). Environmental education within early childhood. In Bodzin et al. (eds.), *The Inclusion of Environmental Education in Science Teacher Education* (pp. 51-64). Doi: 10.1007/978-90-481-9222-9_4.

Pleyvak, L., Bendixen-Noe, M., Henderson, J., Rothe, R. E., & Wilke, R. (2001). Level of teacher preparation and implementation of EE: Mandated and non-mandated EE teacher preparation states. *The Journal of Environmental Education, 32*(2), 28-36.

Project Learning Tree (PLT). (2006). *Project learning tree: PreK-8 environmental education activity guide* (6^{th} ed.). Washington, DC: PLT/American Forest Foundation.

Project WET. (2010). *Project WET (water education for teachers): Curriculum and activity guide*. Bozeman, MT: The Watercourse and Western Regional Environmental Education Council.

Project Wild. (2000). *Project WILD: Curriculum and activity guide*. Houston, TX: Western Regional environmental Education Council.

Rickinson, M., (2001). Special Issue: Learners and learning in environmental education: A critical review of the evidence. *Environmental Education Research, 7*(3), 208-320.

Rillo, T. J. (1974). Basic guidelines for environmental education. *Journal of Environmental Education, 6*(1), 52-55.

Rockcastle, V. (1989). Environmental literacy: Philosophy, content, strategies. *Nature Study, 43*(1-2), 8-9, 22.

Rome, A. (2003). Give earth a chance: The Environmental movement and the sixties. *Journal of American History, 90*(2), 525-554.

Roth, C. (1992). *Environmental literacy: Its roots, evolution and directions in the 1990s*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Roth, C. E. (1984). Elements of a workable strategy for developing and maintaining nationwide environmental literacy. *Nature Study, 37*(3-4), 46-48.

Roth, R. E. (1978). Off the merry-go-round and on to the escalator. In W. B. Stapp (Ed.). *From ought to action in environmental education*. Columbus, OH: SMEAC Information Reference Center, ED 159 046, pp. 12-23.

Saunders, G., Hungerford, H., & Volk, T. L. (1992). Research needs in environmental education: A delphi assessment summary report. *Carbondale, IL: Science and Environmental Education Center, Southern Illinois University*.

Sharp, L. B. (1943). Outside the classroom. *The Educational Forum*, 7(4), 361-368.

Shin, D., Chu, H., Lee, E., Ko, H., Lee, M., Kang, K., Min, B., & Park, J. (2005). An assessment of Korean students' environmental literacy. *Journal of the Korean Earth Science Society, 26*(4), 358-364.

Simmons, D. (2005). Education reform, setting standards, and environmental education. In H. R. Hungerford, W. J. Bluhm, T. L. Volk, and J. M. Ramsey (Eds.), *Essential Readings in Environmental Education* (2nd ed., pp. 65-72). Champaign, IL: Stipes Publishing.

Simmons, D. (1995). Developing a framework for National Environmental Education Standards. In *Papers on the development of environmental education standards* (pp. 10-58). Troy, OH:NAAEE.

Stapp, W. B. 1979. International environmental education: Developing UNESCO's program. *The Journal of Environmental Education, 11*(1), 33-37.

Stevesnon, K. T., Peterson, M. N., Bondell, H. D., Mertig, A. G., & Moore, S. E. (2013). Environmental, institutional, and demographic predictors of environmental literacy among middle school children. PLoS ONE 8(3): e59519. Doi: 10.1371/journal.pone.0059519.

Stern, P. (2000). Toward a coherent theory of environmentally significant behavior. *The Journal of Social Issues, 56*(3), 407.

Udall, S. L. (1963). *The quiet crisis*. New York, NY: Holt, Rinehart and Winston.

UNESCO. (1978). *Final report, Intergovernmental Conference on Environmental Education,* organized by UNESCO in cooperation with UNEP, Tbilisi, USSR, 14–26 October 1977. Paris: Author.

UNESCO. (1987). Moscow '87: UNESCO-UNEP International Congress on Environmental Education and Training. *Connect: UNESCO-UNEP Environmental Education Newsletter, 12*(3), 1-8.

UNESCO-UNEP. (1976). The Belgrade Charter. *Connect: UNESCO-UNEP Environmental Education Newsletter, I*(1), 1-2.

UNESCO-UNEP. (1989). Environmental literacy for all. *Connect, 15*(2), 102.

U. S. Environmental Protection Agency. (2008). Retrieved from http://www.epa.gov/enviroed/basic.html.

Volk, T. & McBeth W. (1997). Environmental literacy in the United States. Washington, DC: NAAEE.

Volk, T., Hungerford, H. R., & Tomara, A. N. (1984). A national survey of curriculum needs as perceived by professional environmental educators. *Journal of Environmental Education, 16*(1), 10-19.

Warren, L. (2003). *American environmental history*. Malden, MA: Blackwell.

Wilke, R. (Ed.). (1995). Environmental Education Literacy/Needs Assessment Project: Assessing environmental literacy of students and environmental education needs of teachers. Final Report for 1993-1995 (pp. 5-6). Stevens Point, WI: University of Wisconsin-Stevens Point.

Wilke, R., (1990). Research in EE: Research and evaluation needs and priorities. *Environmental Communicator*, March/April, 6.

Willis, A. (1999). A survey of the environmental literacy of high school junior and senior science students from a southeast Texas school district. (Doctoral dissertation, University of Houston, 1999). Available in Dissertation Abstracts International: Section A. Social Sciences and Education, *60*(5), 1506.

Wilson, A. H. (2000). A Content Analysis of Environmental Education as Presented in Selected High School Biology Textbooks: 1910–1994. Unpublished dissertation. University of Maryland, College Park, MD.

Wilson, R. (1999). *Starting early: Environmental education during the early childhood years*. Columbus, OH: ERIC Clearinghouse for Science Mathematics and Environmental Education.

Appendix A

IRB Approval

March 29, 2013

MEMORANDUM

TO: [redacted]

FROM: [redacted]
IRB Coordinator

RE: New Protocol Approval

IRB Protocol #: 13-03-575

Protocol Title: *Environmental Literacy of Sixth Grade Students in Arkansas: Implications for Environmental Education Reform*

Review Type: ☐ EXEMPT ☒ EXPEDITED ☐ FULL IRB

Approved Project Period: Start Date: 03/29/2013 Expiration Date: 03/24/2014

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (http://vpred.uark.edu/210.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 4,260 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.

Permission to Use Middle School Environmental Literacy Survey

Center for Instruction, Staff Development and Evaluation
1925 New Era Road
Carbondale, IL 62901

cisde@midwest.net

PH: 618-457-8927

Fax: 618-351-6120

March 14, 2012

Ms. Lisa S. Wood
2916 Archie Watkins Road
Farmington, AR 72730

Dear Ms. Wood:

This letter constitutes permission for you to use the Middle School Environmental Literacy Survey in your doctoral research. Please cite the instrument in the following manner: Hungerford, H.R., Volk, T.L., McBeth, W.C., & Bluhm, W.J. (2009). *Middle School Environmental Literacy Survey*. Carbondale, IL: Center for Instruction, Staff Development, and Evaluation.

I understand that your research will assess environmental literacy levels of 6th grade students across Arkansas, and will compare those literacy scores to a national baseline. You also aim to identify factors that contribute to your findings and to describe the characteristics of environmental education at exemplary schools. Yours is indeed a noteworthy undertaking and will provide important information about environmental literacy and environmental education in Arkansas to educators in your state and to the EE field in general. I wish you well in your research.

You have indicated that you will restrict access to the MSELS to those who are involved or otherwise closely associated with your study. Thank you for that consideration. We prefer that you not include a copy of the instrument in any report. Rather, please indicate that the instrument cannot be distributed or used without permission from the Center for Instruction, Staff Development and Evaluation (CISDE), and provide the contact information contained in our letterhead (land address, telephone and email address). We also request that you secure the used instruments as long as necessary for the parameters of your research, and then that you destroy the booklets.

I wish you speedy work and success as you carry out your study. Please do not hesitate to contact us if you have questions, or if there is some other way that we may be of help. We look forward to receiving a copy of your research report.

Sincerely,

Dr. Trudi Volk, Executive Director
Center for Instruction, Staff Development and Evaluation

Appendix B

Middle School Environmental Literacy Survey

At the request of the Center for Instruction, Staff Development and Evaluation (CISDE), the Middle School Environmental Literacy Survey cannot be provided with this dissertation. All inquiries regarding distribution and use must be directed to:

Dr. Trudi Volk, Executive Director
Center for Instruction, Staff Development and Evaluation
1925 New Era Road
Carbondale, IL 62901
(618) 457-8927 (Phone)
E-mail: CISDE@midwest.net

Appendix C

C-1 Environmental Program Information Form

C-2 Teacher Information and Survey Form

C-3 Letter of Engagement

C-4 Teacher Consent Form

C-5 Passive Parental Consent Form

Appendix C-1

Environmental Program Information Form

Contact Information

Your Name: ______________________________ Date Completed: _____________

School Name: ____________________________ Grade Level: **6th grade**

Contact Phone Number: _____________________ E-Mail: _____________________

Item 1. Does your school offer some type of environmental program for students in 6th grade? _____ No _____ Yes

If you checked "Yes" for Item 1, please complete the remainder of the form.
If you checked "No" for Item 1, please only complete Items 5-8.

Item 2. Name or Theme of Your Environmental Program

a. Does your environmental program have a name (title)?

___ No ___ Yes

b. If "Yes":

* if this program is <u>school-wide or applies to several grades</u>, the name of your environmental program is: ____

* if this program <u>applies only to classes in 6th grade</u>, the name or theme of your environmental program is: ____________________________________

Item 3. Involvement in and Uses of Environmental Education (EE)

a. Is the environmental program for sixth grade affiliated with an EE <u>network</u> (e.g., EIC, Earth Force, Green Schools, Earth Day, Earth Partnership, etc.)?

___No ___Yes

If 'Yes,' please name and briefly describe your participation in each network.

____

____

b. Does your program use any specific EE <u>curricula</u> at this grade level (e.g., PLT, Project WILD, Project WET, Wonders of Wetlands, Windows on the Wild, IEEIA, etc.)?

___No ___Yes

If 'Yes,' please name up to three EE curricula that are most widely used.

* ____
* ____
* ____

c. Has your program consistently used any EE program or approach other than those identified in a. and b. (e.g., federal, state, or local programs; place-based, service-learning, action research; etc.)?

___No ___Yes

If 'Yes," please identify and briefly describe each major program/approach.

* ____
* ____
* ____
* ____

Item 4. Additional Major Features of Your Environmental Program

a. Briefly describe the overall purpose or goals, focus, and scope of the environmental program for the sixth grade.

____

____

Item 5. Which of the following are included as major educational goals and objectives for the 6th grade students? (*Check all that apply*)

___ Knowledge of natural sciences (e.g., natural history, earth sciences, ecology, environmental sciences)
___ Knowledge of social studies (e.g., history, geography, sociology, government, economics)
___ Communication skills (e.g., written and oral communication, graphic communication in math/science)
___ Higher order/critical thinking skills (e.g., inquiry/investigation, analysis, synthesis, and evaluation skills)
___ Development of affective dispositions (e.g., sensitivity, empathy, attitudes, values, responsibility, self-efficacy)
___ Awareness of problems and issues in the community (e.g., health, crime, elderly, pollution, endangered species)
___ Community investigation skills (e.g., library/Internet research, scientific inquiry, social investigation skills)
___ Community service/action skills (e.g., skill in planning, implementing, evaluating, and reporting service projects; interpersonal and media skills)

Item 6. Curricular/Instructional Organization in the 6th grade classes

a. Which of the following <u>best</u> characterizes the <u>curriculum organization</u> ? (*Check only one)*

___ separate subjects with little or no integration

___ treatment of selected common themes in separate subjects

___ treatment of broad common themes through integration of subjects

___ other (please describe): ___________________________________

b. Which of the following <u>best</u> characterizes the <u>organization of teachers</u> in the 6th grade classes? (*Check only one)*

___ self-contained teaching

___ departmentalized teaching

___ cross-disciplinary team teaching

___ other (please describe): ___________________________________

c. Which of the following are the <u>most common ways</u> in which students are <u>organized for instruction</u> in the sixth grade class(es)? (*Rank each that is used, with 1=most common, 2=next most common, and so on)*

___ whole class

___ groups/teams

___ individualized

___ other (please describe): ___________________________________

Item 7. Does your school have an outdoor classroom or community garden? (circle)

If so, how often is the teaching/learning space incorporated into the instruction?

____

Is the space used for interdisciplinary instruction or primarily science instruction?

____

Item 8. Does your school organize any of the following activities to provide opportunities for students to learn more about environmental topics?

_____ trips to museums

_____ trips to science centers

_____ extracurricular environmental projects

_____ community service projects (park clean-ups, restorations projects, etc.)

____ trip to outdoor/environmental education center or science center/camp
If so, is it a ____ residential or ____ day camp experience?

Item 9. Briefly describe any other major features of the environmental program in the 6th grade curriculum that are not clearly or adequately identified in previous items. (e.g., after-school clubs, school greening projects, community gardens, etc.).

____

____

____

____

____

____

____

____

Thank you for completing this form!

Appendix C-2

Teacher Information Form and Survey

(to be completed by each teacher responsible for teaching EE and/or science to the 6th grade students)

Contact Information

Your Name: ____________________________ Date Completed: ________________

School Name: ___________________________ E-mail: _______________________

Item 1. Your Years of Teaching Experience
For how many year have you been teaching ...

a. ... at any/all levels, K-12 (total number of years)? _______________________

b. ... at the middle grades level (grades 5-8)? ___________________________

Item 2. Your Teaching Position(s)
a. For your current teaching position, please check the grade level(s) and subject area(s) in which you teach.

Grade Level(s): __5 __6 __7 __8 __Other (ID): __________________

Subject Area(s): __Science __Math __Social Studies

__English __Health/PE

__Other (ID): ____________________________

b. For previous teaching positions (years teaching), please check all grade level(s) and subject area(s) in which you have taught. (*Check all that apply*)

Grade Level(s): __5 __6 __7 __8 __Other (ID): _________________

Subject Area(s): __Science __Math __Social Studies

__English __Health/PE __Other (ID): ____________________________

Item 3. Your Teaching Certificate(s)
a. Are you currently certified to teach in Arkansas? *(Check one)*

___ Yes, I am.

___ No, but I am currently working toward certification.

___ No, I am not.

Item 3. Your Teaching Certificate(s) (*continued*)

b. Please identify each professional teaching certificate you have earned. (*Please do not include temporary certificates*)

Early/Elementary: ____

Middle Grades: ____

Secondary: ____

Other: ____

c. Please identify each <u>add-on certificate/endorsement</u> you hold (if any).

* ____

* ____

* ____

* ____

Item 4. Higher Education Degrees You Earned
Please check each degree you have earned (left column), and identify the area(s) in which you have earned each degree (right column).

___ Bachelors, Area(s): _____________________________________

___ Masters, Area(s): _______________________________________

___ Masters + 30, Area: _____________________________________

___ Specialist, Area: _______________________________________

___ Doctorate, Area: ____

___ Other (ID Type & Area of Degree): _______________________

Item 5. Your Environmental Education (EE) Training
a. How many <u>college/university courses</u> in or involving EE have you completed in each of the following areas?

___ EE content ___ combined EE content/methods

___ EE methods ___ EE field/clinical experience

___ EE foundations ___ Other (ID): ___________________

Item 5. Your Environmental Education (EE) Training (*continued*)

b. Over the last 10 years, approximately how many <u>inservices/workshops</u> in EE have you completed? ________________________________

How many of those fit each time period (length) below?

____ less than a full day ____ between 3-7 days

____ between 1-2 days ____ longer than a week

c. Identify and briefly describe any EE course(s) and inservice workshop(s) that have had a direct influence on your middle grades class (e.g., you still use those methods or materials).

* ____

* ____

Item 6. Your Gender ___Female ___Male

Item 7. Your Age Group

___under 21 ___21-30 ___31-40 ___41-50 ___ 51-60 ___ over 60

Item 8. Your Ethnic/Racial Background (*Check the best response*)

___ American Indian/Alaskan Native

___ Asian/Pacific Islander

___ Hispanic

___ Black (non Hispanic)

___ White (non Hispanic)

___ Biethnic/biracial (*any two of the above*)

___ Multiethnic/multiracial (*more than two of the above*)

Item 9. Your Views on Environmental Education (EE)
(*Circle the number that best reflects your thoughts/feelings*)

a. How important is it that K-12 students are exposed to EE?

____1_____________2_____________3_____________4_____________5____
Not at all Slightly Moderately Considerably Extremely

b. How important is EE to you personally?

____1_____________2_____________3_____________4_____________5____
Not at all Slightly Moderately Considerably Extremely

Item 10. Your Views on the Environment
(*Circle the number that best reflects your thoughts/feelings*)

10.1. To what extent do you feel that you are "environmentally sensitive"? This means that you appreciate and care about the environment.

____1_____________2_____________3_____________4_____________5____
No Extent A Moderate Extent A Great Extent

10.2. To what extent do you take part in recreational activities which take place in natural places such as parks and wilderness areas (e.g., camping, hiking, canoeing, fishing, hunting, etc.)?

____1_____________2_____________3_____________4_____________5____
No Extent A Moderate Extent A Great Extent

10.3. To what extent do you believe the environmental problems in the U.S. have been exaggerated?

____1_____________2_____________3_____________4_____________5____

No Extent A Moderate Extent A Great Extent

10.4. To what extent do you oppose environmental laws and regulations designed to help protect the environment?

____1____________2____________3____________4____________5____

No Extent A Moderate Extent A Great Extent

10.5. To what extent are you concerned about the loss of natural areas and habitats?

____1____________2____________3____________4____________5____

No Extent A Moderate Extent A Great Extent

10.6. To what extent are you concerned about the effects of air and water pollution on humans?

____1____________2____________3____________4____________5____

No Extent A Moderate Extent A Great Extent

10.7. To what extent do you believe that the economy significantly worsens environmental problems in the U.S.?

____1____________2____________3____________4____________5____

No Extent A Moderate Extent A Great Extent

10.8. To what extent do you believe the economy will play the most significant role in solving environmental problems in the U.S.?

____1____________2____________3____________4____________5____

No Extent A Moderate Extent A Great Extent

10.9. To what extent do you believe that technology significantly worsens environmental problems in the U.S.?

____1____________2____________3____________4____________5____

No Extent A Moderate Extent A Great Extent

10.10 To what extent do you believe technology will play the most significant role in solving environmental problems in the U.S.?

____1____________2____________3____________4____________5____

No Extent A Moderate Extent A Great Extent

10.11. To what extent do you believe that you can influence the solution of an environmental issue by acting on your own?

____1____________2____________3____________4____________5____

No Extent A Moderate A Great

Extent Extent

10.12. To what extent do you believe that you can influence the solution of an environmental issue by acting with others?

____1____________2____________3____________4____________5____
No Extent A Moderate Extent A Great Extent

10.13. To what extent do you feel it is your personal responsibility to help improve environmental quality in your community?

____1____________2____________3____________4____________5____
No Extent A Moderate Extent A Great Extent

10.14. To what extent do you feel it is also other people's responsibility to help improve environmental quality in your community?

____1____________2____________3____________4____________5____
No Extent A Moderate Extent A Great Extent

10.15. To what extent are you willing to work on your own toward the solution of environmental issues in your community?

____1____________2____________3____________4____________5____
No Extent A Moderate A Great

10.16. To what extent are you willing to work with others toward the solution of environmental issues in your community?

____1____________2____________3____________4____________5____
No Extent A Moderate Extent A Great Extent

Items 11-13 refer to your own classroom environment

Item 11. Which of the following teaching/learning settings do you use with your students? (Check all that are prominent or commonly used)

____ classrooms ____ science lab
____ computer lab ____ school library
____ school grounds ____ field trip/study sites
____ community settings ____ other ________________________

Item 12. Please list up to three teaching methods/strategies that are most commonly used in your 6th grade classes.

______ Lecture ______ Labs

_______ Discussion _______ Projects
_______ Cooperative Learning _______ Inquiry-based instruction
_______ Hands-on _______ Service Learning
_______ Other (please identify)____
_______ Other (please identify)____
_______ Other (please identify)____

Item 13. Which of the following <u>assessment approaches</u> are used in your 6th grade classes? (*Rank those that are most important for assessing student progress, with 1=most common)*

___ informal assessment (teacher observations, teacher questions/student responses, student interviews)

___ alternative/authentic assessment (performance tasks, papers and projects, other portfolio entries)

___ traditional assessment (teacher-made quizzes and tests)

___ standardized assessment (state achievement tests, items taken from or similar in format to achievement tests)

___ other (please describe): ____
____

Any additional comments?

Thank you for taking the time to complete this survey.

Appendix C-3

LETTER OF ENGAGEMENT

Environmental Literacy Assessment of 6^{th} Graders in Arkansas

Date: ___________________________

Principal: ____

School: ____

□ My school will **NOT** participate in the research study.

(**Please sign on reverse side and return form in envelope provided; no further action is required**)

□ I **agree,** on behalf of the school, to participate in this research study and will ensure participating teachers and students complete all required forms and surveys.
(**Please fill out information below**)

1. Number of 6^{th} grade teachers who teach science: ______________

   Names of those teachers: ____
   ____
   ____

2. Name of teacher who is most qualified to complete the Program Information Form for 6^{th} grade:____

   Alternate Teacher: ____

3. The following questions are essential for scheduling purposes:

   - Current 6^{th} grade enrollment: ___________________
   - Will it be possible to survey/test all 6^{th} grade students during one class period? _________ If not, how many class periods will be needed? ______
   - What are the dates of your standardized testing in the spring?

     ____
   - When would be an ideal time to schedule the student data collection during April- June? ____

4. Assuming the student survey/test is the 6^{th} grade activity for the day, will you allow the use of Passive Consent Forms? ___________

Thank you for your time and consideration.

________________________________ ___________________
Signature Date

____
Position

Appendix C-4

TEACHER INFORMED CONSENT FORM
Environmental Literacy Assessment Project

You and the 6th grade students at your school were selected to participate in a state-wide assessment of environmental literacy. This survey is adapted from the "National Environmental Literacy Assessment Project" recently completed. The information below addresses the consent requirements of this study. Please read through this information carefully and sign at the bottom to consent to participation.

The purpose of this study is to explore the level of environmental literacy among 6th graders in public schools across Arkansas. Forty schools were randomly selected based on a stratified random sample stratified on zip code for geographic representation and 6th grade enrollment. Your Principal was asked if your school would participate in this study. You are being asked to participate because he/she agreed.

As a 6th grade science teacher, you are being asked to complete a Teacher Information and Survey Form which has been designed to gather information about the science teacher(s) for the students at your school. We estimate the form will take approximately 30 minutes to complete.

While the form asks for the teacher's name this is done solely to (1) identify the teacher who completed the form should there be any need for follow-up; and (2) permit the Program Information Form and Teacher Form to be linked to the completed surveys for your students during the data entry and analysis. Please note that each school, class, and teacher will be assigned a unique ID number during data entry. Thus, the only person who will know the names of those involved is me as the Principal Investigator. Data will be kept confidential to the extent allowed by law and University policy. No other researcher will know your name or be able to connect your responses to you. None of your responses will ever be singled out in reports or presentations of the results of this project. This research does not pose any foreseeable risks or discomforts nor any direct benefit to the participants.

If you agree to participate, please sign and date this form as indicated below. Also, please complete the Teacher Information and Survey Form and return it to me in the enclosed envelope by March 29, 2013. Thank you for agreeing to participate.

If you do not wish to participate in this survey, please discuss this with your School Principal as he/she has agreed that the school will participate completely in the research study.

If you have questions or concerns about this study, you may contact [redacted]. For questions or concerns about your rights as a research participant, please contact [redacted], the University's IRB Coordinator, at (479) 575-2208 or by e-mail at [redacted]

Consent

I have read and understand the above information and I agree to participate in the study. I have received a copy of this form.

Teacher's Signature ________________________________ Date _____________________Teacher's

Printed Name _____________________________ E-mail ____________________

Appendix C-5

PASSIVE PARENTAL CONSENT FORM
Environmental Literacy Assessment Project

Your child's school was selected to participate in a statewide survey of environmental literacy among 6th grade students in public schools across Arkansas. This survey is a follow-up to the "National Environmental Literacy Assessment Project," a research project funded by the Environmental Protection Agency (EPA), and supported by the National Oceanic and Atmospheric Administration (NOAA) and North American Association for Environmental Education (NAAEE). The information below addresses the parental consent requirements of this study. Please read through this information.

The purpose of this survey is to explore the level of environmental literacy among 6th grade students in public schools across Arkansas. The sample for this survey was selected based on a stratified random sampling of all schools with 6th grade students. Researchers asked the Principals at 40 randomly chosen schools if the school could participate in this survey. You are receiving this form because the Principal at your child's school agreed to participate. **All 6th grade students at your child's school will be given the survey at a scheduled time during the normal school day**.

This pencil-and-paper survey consists of seven sections, and is designed to gather information on students' environmental knowledge, skills, affective characteristics (feelings), and participation, as well as their age, gender, and ethnic background. This survey will be administered by one of the researchers in a supervised school setting approved by the School Principal during normal school hours, and will take approximately 50-60 minutes to complete.

The survey and Researcher will not ask for your child's name, and if any child does write in her/his name on the response form, it will be erased. Thus, no one on the research team will ever know your child's name or be able to connect your child's response to her/him. Beyond this, no individual student's responses will ever be singled out in reports or presentations of the results of this survey. Data collected will be kept confidential to the extent allowed by law and University policy. **This research does not pose any foreseeable risks or discomforts to the participants or any direct benefits to the participants**.

It is hoped that this survey will result in an improved understanding of environmental literacy in the middle grades across Arkansas. A report of this survey will be published as a Dissertation, and results will be presented at conferences and in research journals. Upon request, the researchers will forward a summary of the survey results to your child's school. Beyond this, these survey results may be used to guide improvements to environmental education programs for the middle grades.

If you **will** allow your child to participate, **you do not need to do anything**. However, if you **do not** want data collected from your child's participation included in this study, please sign and date the bottom portion of this form, check the box below, and have your child return the form to his or her teacher. If you do this, your child's teacher will give him/her an alternative activity while the other students are taking the survey.

If you have questions or concerns about this study, you may contact [redacted]

☐ I **DO NOT** want data collected as a result of my child's participation included in the research study.

Child's Name   Signature of Parent or Guardian; Date

______________________________   ______________________________