

THE EFFECT OF ENVIRONMENTAL CHARTER SCHOOL PARTICIPATION ON
THE ENVIRONMENTAL LITERACY LEVELS OF 6th GRADE STUDENTS

Presented in Partial Fulfillment of the Requirements for
The Master of Education in Environmental Education in the
College of Education and Human Service Professions

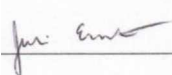
By

Jennifer A Polisenio, B.A.

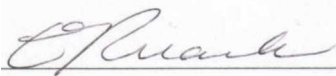
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Abstract

This study lies in the need to better understand EE's contribution to fostering environmental literacy of young students. In the coming years, students will be called upon to understand complex environmental issues and make informed decisions in their private and public lives. All this comes at a time when young people are less connected to the natural world (Mertz, 2010). This study used the Middle School Environmental Literacy Survey to explore the environmental literacy level of 6th grade students at an environmental charter school. The purpose of this study was to explore the effect of environmental charter school participation on the environmental literacy levels of 6th grade students.

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Chapter 1

Introduction

Background

Environmental education's primary aim has been to develop an environmentally literate citizenry (North American Association for Environmental Education, 2008). For a person to be considered environmentally literate, they must possess the knowledge, skills, behaviors, and attitudes concerning the environment (Hollweg, Taylor, Bybee, Marcinkowski, McBeth & Zoido, 2011a). While the scope of environmental education (EE) in the U.S. has been much greater than it was since its foundation, it has not yet resulted in widespread environmental literacy (Elder, 2003). The National Environmental Education Training Foundation (NEETF) has called for efforts to increase environmental literacy, specifically suggesting the need for EE for all ages (Coyle, 2005). This has suggested that EE has the potential to increase environmental literacy, but that this potential has perhaps not yet been reached.

Hungerford and Volk, in their theory of *Responsible Environmental Behavior* suggested, "citizenship behavior can be developed through environmental education. The strategies are known. The tools are available. The challenge has laid in a willingness to do things differently than we have in the past" (1990b, p. 8). Thus, it has been important to understand how newer and more systemic forms of environmental education, such as place-based programs, *Environment as an Integrating Context* programs, and environmental charter schools, have influenced environmental literacy in U.S. youth.

With the primary goal of public education having been to prepare young people for the responsibilities of citizenship, the vision of environmental literacy has been well

aligned with this goal (Archie, 2003). Elder suggested, “the vision of universal environmental literacy has the potential to be a tremendous unifying goal in our society, as it is fully consistent with deeply held American values and integrates concerns and issues in environment, education, business and community development, as well as other sectors” (2003, p. 31). He further suggested that environmental education has been a “powerful and often overlooked tool that offers tremendous potential for accelerating a fundamental shift in the nation’s education” (2003, p. 31). Thus, a better understanding of the contribution of environmental education to formal education in terms of both educational and environmental outcomes has been critical.

Purpose

The purpose of this study was to explore the effect of environmental charter school participation on the environmental literacy levels of 6th grade students.

Research Questions

1. What is the environmental literacy level of 6th grade participants in an environmental charter school?
2. How does their environmental literacy compare to the average environmental literacy level of middle school youth in the U.S.?
3. How does their environmental literacy compare to the environmental literacy level of 6th grade youth in a non-environmental school?

Definition of Terms

Environmental Education

Environmental education teaches children and adults how to learn about and investigate their environment. Environmental education teaches children to make intelligent, informed decisions about how they can take care of the environment (NAAEE, 2011).

Environmental Literacy

Environmental literacy is the capacity of an individual to act successfully in daily life on a broad understanding of how people and societies relate to each other and to natural systems, and how they might do so in a sustainable manner (Elder, 2003). Someone who is environmentally literate makes informed decisions concerning the environment individually as well as with others (Hollweg et al., 2011a). For this study environmental literacy has been operationalized as one's score on the Middle School Environmental Literacy Survey.

Charter School

Charter schools “are publicly funded, independently operated schools that are allowed to operate with more autonomy than traditional public schools in exchange for increased accountability” (National Charter School Resource Center, n.d, para. 1).

Environmental Charter School

Environmental Charter Schools are charter schools that are environment-focused. This means that the curriculum and education programs are geared at creating an environmentally literate person (Green Schools National Network, 2011).

Limitations

Because of the costs associated with the middle school environmental literacy survey, there was no pre-test to measure the student's environmental literacy level prior to participation. Only a post-test was administered to the participants. Thus, while results indicated the environmental literacy levels of students in an environmental charter school, it has been unclear based on this design as to whether their levels are due to participation or to some other factor. Due to difficulty in finding an equivalent comparison group, a nonequivalent comparison group was used. The two participating schools were different in location, surrounding area, in school size, and socioeconomic status. It was difficult in finding a non-environmental charter school willing to have their students take a one-hour test that did not seem relevant. This likely resulted in an internal threat to the validity of the design of the study.

Significance

The significance of this study lies in the need to better understand EE's contribution to fostering environmental literacy of young students. In the coming years, students will be called upon to understand complex environmental issues and make informed decisions in their private and public lives. All this comes at a time when young people are less connected to the natural world (Mertz, 2010). Thus, increasing environmental issues will continue to face children's future and the need to be environmentally literate will be critical.

The current research of McBeth and Volk (2010) has focused on the environmental literacy of students at the middle school grade level. Their aim was to

develop a national baseline for environmental literacy. This baseline provided a consistent measure for environmental literacy of middle school students to be used in future studies. This baseline allowed schools to know how they compare in regards to the rest of the nation (McBeth & Volk, 2010). The Middle School Environmental Literacy Survey (MSELS) baseline was important in the further development of additional environmental literacy instruments including those designed for younger and older students. MSELS was “the first in a series of literacy assessments that may help us understand where we stand with respect to environmental literacy in the United States” (McBeth & Volk, 2010, p. 64). This study used the national baseline as a comparison for 6th grade students at an environmental charter school.

Chapter 2

Literature Review

The literature review addressed several predominate themes focused on environmental education (EE). The review addressed what EE is and how EE is used in formal education settings. Lastly, the review addressed the components of environmental literacy and how environmental literacy is measured.

Environmental Education

Environmental education, as defined by the North American Association for Environmental Education (NAAEE), is an education process designed to teach children and adults how to learn about and investigate their environment. Environmental education has aimed to teach children to make informed decisions about how they can take care of the environment (NAAEE, 2011). The Tbilisi Declaration, resulted from an intergovernmental conference on EE in 1977, stated “environmental education should be provided for all ages, at all levels and in both formal and non-formal education” (UNESCO, 1977, p. 1).

The Tbilisi Declaration of 1977 has provided universally-adopted overall aims and objectives of EE. The Tbilisi Declaration along with recommendations from the Intergovernmental Conference on EE provided “framework, principles, and guidelines for EE at all levels- local, national, regional and international- and for all age groups” both within and outside of the formal education system (UNESCO, 1977, p.2).

According to this Declaration, the aims of EE were:

1. To foster clear awareness and concern about “economic, social, political and

ecological interdependence in urban and rural areas.”

2. To provide opportunities for every person to acquire the “knowledge, values, attitudes, commitments and skills needed to protect and improve the environment.”
3. To create “new patterns of behavior of individuals, groups, and society as a whole towards the environment.” (UNESCO, 1977, p. 3)

The Declaration further outlined objectives for EE, which are stated as follows:

1. Awareness: obtain an awareness and sensitivity to the environment as a whole and its associated problems;
2. Knowledge: to gain a variety of experience in and acquire a basic understanding of the environment and its associated problems;
3. Attitudes: acquire a set of values and feelings of concern for the environment and the motivation to become an active participant for the improvement and protection of the environment;
4. Skills: to acquire the necessary skills in identifying and solving environmental problems; and
5. Participation: providing an opportunity to be actively involved in working to resolve environmental problems (UNESCO, 1977).

In addition to the above goals and objectives for EE, the Tbilisi Declaration also endorsed guiding principles for EE. There are twelve guiding principles laid out in the declaration. While all of the guiding principles have been relevant to EE, the five below are of particular importance to this study:

1. EE should “be a continuous lifelong process, beginning at the pre-school level and continuing through all formal and non-formal stages;”
2. EE should “be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;”
3. EE should “enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;”
4. EE should “emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem solving skills;” and
5. EE should “utilize diverse learning environments and a broad array of educational approaches to teaching/learning about and from the environment with due stress on practical activities and first-hand experiences” (UNESCO, 1977, p. 3).

Settings Where EE Occurs

Environmental education has occurred in a range of formal, non-formal and informal educational settings. These forms of education, “formal, non-formal, and informal education, should be viewed as predominate modes of learning” (Belle, 1982, p.4).

Formal education has typically consisted of lower primary (preK-5th) grades through higher education at the university level. Formal education has commonly happened within an institutionalized setting such as a school building. Such settings include public and private schools and publicly funded magnet and charter schools. Students in a formal educational setting, traditionally have been assessed and graded for

their work and learning in a structured educational system (Belle, 1982).

Non-formal education has consisted of any audience from young children to adults. Non-formal education has been considered any educational activities that have happened outside the framework of the formal setting. Since non-formal education has happened outside the framework of the formal setting it has provided selected types of learning for all ages (Belle, 1982). Examples of non-formal EE would be education at nature centers, zoos, aquariums, and environmental learning centers.

Informal education has been considered the acquiring of knowledge, skills, attitudes and insights from daily experiences. Informal education would be a lifelong process for all ages (Belle, 1982). An example of informal environmental education would be electronic or print media such as websites, magazines, or television.

Formal education was the focus for this study. The use of EE in the formal educational setting specifically focused on schools that use EE, and how the use of EE has related to a student's environmental literacy.

Environmental education in formal education settings

Methods and approaches

There have been various methods of EE used in formal education settings. Many EE methods and approaches have been used in schools because they can be tied to academic standards in the core subject areas of math, science, and reading (EETAP, 2004).

Insertion has been an EE approach that has included the addition of an environment-based unit into a class or curriculum (EETAP, 2004). An example of

insertion would be a course supplement. This has been a popular and straightforward way that formal educators have incorporated EE into school lessons. These supplements are designed to be included in already existing curricula. This has been a convenient way for teachers to add environmentally focused supplements to their curriculum without having to create an entirely new lesson plan. An example of this type of curriculum would be Project Learning Tree, Project Wet, and WILD (Elder, 2003).

The infusion approach has brought an environmental perspective and content into formal education courses. Infusion “is the incorporation of environmental concepts, activities, and examples into existing curricular goals” (EETAP, 2004, p. 1). An example of the infusion approach would be testing water quality in a chemistry class or reading Henry David Thoreau in an English class (Elder, 2003). The infusion method has been a way that teachers have added environmentally based lessons into their curriculum by incorporating the environment.

Many educators have used the environment as a foundation for various educational approaches such as place-based education and project-based education. Place-based education has used the local community as the focus for integrating math, science, and history by infusing these subjects into community guided projects. Project-based education has used a driving question as the basis for students to investigate a real world problem through active investigations. Multiple content areas are used in the exploration. Students have learned through an inquiry process and created thoughtfully designed projects. These educational approaches have emphasized hands-on-learning, the development of critical thinking and problem solving skills, and student initiative as

well as a grasp of concepts that span academic disciplines (Archie, 2003).

In addition to various methods and approaches used for incorporating EE into classroom curricula, individual schools have transformed the entire school into an environmental-based school that has encompassed EE into every class. One common approach that schools have used is an *Environment as an integrating context* (EIC) model™. This model has focused on using school surroundings and community as a framework within which students have constructed their own learning guided by the educator. The EIC model™ has been widely recognized as a very effective and comprehensive model for environmental literacy (Elder, 2003).

The EIC model™ has been developed, copyrighted, and trademarked by the State Education and Environment Roundtable (SEER). This model is a system of educational practices using the environment as a context for the improvement of student learning (Lieberman, 2005). The EIC model™ encompassed six approaches that schools, which have implemented this model, employ. These six approaches were further discussed below, they were:

- Integrated-interdisciplinary instruction;
- Community-based investigations;
- Collaborative instruction;
- Learner-centered, constructivist approaches;
- Combinations of independent and cooperative learning; and
- Local natural and community surroundings, as the context for learning (Lieberman, 2005).

Integrated-interdisciplinary instruction has broken down the traditional boundaries among disciplines. Schools that are considered successful at implementing the EIC model™ used integrated-interdisciplinary instruction that provided students with opportunities to explore connections between subject area disciplines, organized student learning between subject areas and class periods, and developed comprehensive understanding of natural and social systems by breaking down traditional disciplinary boundaries (Lieberman, 2005).

Community-based investigations have been experiences offered through service-learning opportunities that have been constructivist experiences and promoted cognitive development. Students have been offered opportunities to apply their skills and knowledge in their local and surrounding communities. Students have been given the opportunity to investigate real-world issues and problems within their community. According to Lieberman, with this opportunity, students have been encouraged to use their higher-level thinking skills, problem-solving skills, and creative-thinking skills to have achieved “comprehensive understanding of the complexity of real-world problems and issues involving the interaction of their natural surroundings with diverse cultural, economic, and political perspectives and interests” (2005, The EIC Model™, para. 2).

Collaborative instruction has connected teacher instruction and learning with teachers, parents, students, and community members. This has allowed for student and community members to be involved in collaboration as well as provided opportunities for teachers to model positive team relationships (Lieberman, 2005).

Learner-centered, constructivist approaches have been adapted for the unique

abilities and needs of individual students. Educators have taken into account “students’ individual learning styles, multiple intelligences, and cultural backgrounds to insure effective instructional design and practices in the context of local community” (Lieberman, 2005, The EIC Model™, para. 2). Educators have supported student goals and objectives, allowed students to construct their own understanding, and assisted students in self-directed inquiry studies (Lieberman, 2005).

Combinations of independent and cooperative learning have guided students in the development of team and group work skills. Educators have ensured that teams are well balanced and included a wide range of learning styles and ability levels (Lieberman, 2005).

Local natural and community surroundings are used as a venue to improve teaching and learning. Local natural and community surroundings are used as a context for “interconnecting all of the educational practices of the EIC model™ into a comprehensive school improvement strategy” (Lieberman, 2005, The EIC Model™, para. 2).

The EIC model™ has laid out methods to improve teaching and learning. Schools that have implemented the EIC model™ have seen higher student achievement from having used this approach. According to Lieberman & Hoody, EIC students “scored higher on three of four comparative studies of standardized science achievement data, than their peers from traditional programs” (1998, p.7).

Environmental Charter Schools

Charter schools “are publicly funded, independently operated schools that are allowed to operate with more autonomy than traditional public schools in exchange for increased accountability” (NCSRC, n.d, para.1). With the intention of an improved national school system, charter schools have been a new and innovative approach with the goal of improved student achievement (National Alliance for Public Charter Schools, 2008).

There have been many studies conducted which focused on student achievement. These studies suggested that students attending charter schools experienced “similar or greater achievement than students in comparable traditional public schools” (National Alliance for Public Charter Schools, 2008, para.1). Charter schools have had the freedom to use innovative ways to improve student learning. Because of this, environmental charter schools have been able to form and have made their focus environmental education (Green Schools National Network, 2011).

Environmental charter schools are charter schools that are environment-focused. This means that the curriculum and education programs have been geared at creating an environmentally literate person (Green Schools National Network, 2011). The Green School National Network is a national non-profit organization for environment-focused schools. In Minnesota alone, there are several schools that are listed as green charter schools (Green Schools National Network, 2011).

As stated by the Green Schools National Network, the impact of environmental charter schools has been that, “educating for sustainability helps young people to gain the

knowledge, skills, motivation and hands-on experiences to make the world a better place for everyone and everything” (Green Schools National Network, 2011). When done correctly, “EE can help achieve an improved environment, better- planned communities, a more vibrant economy, and even optimal human health” (Coyle, 2005, p. xvii).

Environmental Literacy

Defining Environmental Literacy

Environmental literacy has been defined as, the capacity of an individual to act successfully in daily life on a broad understanding of how people and societies relate to each other and to natural systems, and how they might do so in a sustainable manner (Elder, 2003). Environmental literacy has combined the knowledge, attitudes, and behaviors within the context of the environment (SEEK, n.d., Minnesota Report Cards on Environmental Literacy). According to the NAAEE’s *Developing a Framework for Assessing Environmental Literacy*, an environmentally literate person has been defined as “someone who, both individually and together with others, makes informed decisions concerning the environment” (Hollweg et al., 2011a p. 3). Those that are considered environmentally literate possess cognitive, affective and behavioral components. According to the NAAEE these components are knowledge, dispositions, competencies, and environmentally responsible behavior. The environmental literacy component of knowledge included the knowledge and understanding of physical and ecological systems and environmental issues; and knowledge of multiple solutions to environmental issues (Hollweg et al., 2011a). The environmental literacy component of dispositions is considered positive and negative determinants of environmental behaviors. Dispositions

toward the environment are thought to influence learners' "willingness to recognize and choose among value perspectives, as well as their motivation to participate in public deliberations about environmental issues" (Hollweg et al., 2011a p. 4). The environmental literacy component of competencies has been considered skills and abilities related to environmental issues and have included the ability to have identified, analyzed and investigated environmental issues, asked relevant questions, and have made personal judgments that used evidence and knowledge that defended positions and resolved issues, and created and evaluated plans that resolved environmental issues (Hollweg, et al., 2011a). Finally, the environmental literacy component of environmentally responsible behavior has been considered the "ultimate expression of environmental literacy" (Hollweg et al., 2011a p. 3). This component has combined the other 3 environmental literacy components and has been applied to "make sound and effective decisions in a range of environmental contexts" (Hollweg et al., 2011a p.3). Therefore, these components have been what an individual needs to possess if they are to be considered environmentally literate. Environmental literacy has not been stagnant over time but has changed as personal beliefs have changed. It has been thought of as active; as personal beliefs, experiences, behaviors, and social influences have changed; environmental issues will then develop and evolve (Hollweg et al., 2011a).

In 1990, a panel of professional environmental educators and researchers identified the need for measures of environmental literacy as part of a national research agenda for EE (Wilke, 1990). Since 1990 there have been a number of environmental literacy frameworks published, such as the *Assessment of Learning Outcomes in*

Environmental Education (1990), *Wisconsin Center for Environmental Education* (1992), *Environmental Literacy: Its Roots, Evolution and Direction in the 1990s* (1992), and *Environmental Education Literacy Consortium* (1994) (Hollweg et al., 2011b). These frameworks, such as the NAAEE's new framework for assessing environmental literacy, have guided research and the development of assessment instruments of environmental literacy (Hollweg et al., 2011b). It has been more than 10 years since this need was identified and yet it has only been recently that studies have begun to measure the environmental literacy of the nation's schools (McBeth & Volk, 2010).

Assessing Environmental Literacy

Environmental literacy has been measured by an individual's knowledge, attitude, cognitive skill, and behavior in regards to the environment. Some recent measures of environmental literacy have included *Environmental Literacy in America*, a report by NEEFT. This report had found that adults thought they knew more about the environment than they actually did (Coyle, 2005). Minnesota had done a similar study on adult environmental literacy with the *Minnesota Report Card on Environmental Literacy*. In 2008, the most recent report card was a survey conducted by telephone. After having surveyed 1,000 residents, the report card concluded that about 43% of respondents have an above-average knowledge about the environment (Murphy, 2008).

In 2006, researchers took on the task of a national environmental literacy assessment that provided a baseline of environmental literacy among middle school students in the United States. Researchers wanted to learn what middle school age students know, think, and feel about the environment (McBeth & Volk, 2010). The

Middle School Environmental Literacy Survey (MSELS) was based on Hungerford, Volk, McBeth and Bluhm's Middle School Environmental Literacy Instrument (MSELI). (McBeth & Volk, 2010). The MSELI included "several demographic items and measures of the following environmental literacy components: ecological knowledge; verbal commitment; actual commitment, or environmental behavior; environmental sensitivity; general environmental feelings; issue identification and issue analysis skills; and action planning" (McBeth & Volk, 2010, p. 58).

The MSELS by Hungerford, Volk, McBeth and Bluhm was based off of the Middle School Environmental Literacy Instrument developed and field-tested in 1995 by Bluhm, Hungerford, McBeth and Volk (McBeth & Volk, 2010). The MSELS contained 75 multiple-choice and Likert-type items. The researchers obtained 2,004 usable responses from 6th and 8th grade students that were included in the data analyses. The overall (adjusted) composite scores of the MSELS were classified as low (24-96), moderate (97-168), or high (169-240). These ranges were based on a possible score that ranged from 24-240. The weighted scores for the four components of environmental literacy were also classified into low, moderate and high; ecological knowledge, environmental affect (verbal commitment, environmental sensitivity, and general environmental feelings), cognitive skills (issue identification, issue analysis, and action planning), and behavior (actual commitment). Ecological knowledge and cognitive skills were classified as low (0-20), moderate (21-40), and high (41-60). Environmental affect and behavior were classified as low (12-27), moderate (28-44), and high (45-60). The results of the MSELS found that middle school aged students, as a group, were

considered to have a moderate environmental literacy level (142.14). For the four components of environmental literacy the MSELS results found that 6th grade students were considered moderate to high in their ecological knowledge (39.67), have shown moderately positive attitudes toward the environment (38.44), and have been willing to make positive actions toward the environment (40.73). However, 6th grade students rated higher in expressing positive attitudes and willingness to make positive actions toward the environment, while older students (grade 8) rated higher in their ecological knowledge (41.01) (McBeth & Volk, 2010). These results were obtained from student responses on the MSELS and were scored based on the percentage of points possible for each specific environmental literacy component (McBeth & Volk, 2010).

The MSELS was part of the National Environmental Literacy Assessment (NELA), a three-phase national environmental literacy study of 6th and 8th grade students in 48 schools in the United States. The NELA was in response to recommendations given by the U.S. Environmental Protection Agency's (EPA) National Environmental Education Advisory Council (NEEAC). The recommendations were to "conduct a national measure of environmental literacy and to understand the relative effectiveness of instructional materials in meeting the goals of EE and environmental literacy" (Office of Education, 2008, p.4). Though not the focus of the NELA, it was noted in the results that schools which stated they used EE in the classroom scored higher than schools that did not report the use of EE (Office of Education, 2008). Thus, it would seem that students in schools with an environmental focus would have a higher level of environmental literacy than students in non-environment-based schools.

Summary

As discussed, there are many EE programs, approaches and methods that have been used in the formal education setting. The use of EE in the formal education setting has thought to increase the environmental literacy of students. Schools that have implemented the EIC model™ have reported higher academic achievement of their students (Archie, 2003). One study that focused on the EIC model™ indicated, “students learn more effectively within an environment-based context than within a traditional educational framework” (Lieberman & Hoody, 1998, p. 5). In addition, the results of the NELA suggested the potential for an increase in environmental literacy of students through EE in formal school settings. Environmental education has provided the starting point to help build the environmental literacy of students. The overall aims and guiding principles of EE have laid the foundation for an increased environmental literacy. Through various approaches, methods, and programs implemented in the formal educational setting, EE has been found to be an effective tool that has driven environmental literacy. However, additional evidence of formal education influence on environmental literacy would be needed, and in particular an understanding of what types of EE would have the potential to increase environmental literacy.

Chapter 3

Methodology

The purpose of this quantitative study was to explore the effect of environmental charter school participation on the environmental literacy level of 6th grade students. The following research questions were addressed:

1. What is the environmental literacy level of 6th grade participants in an environmental charter school?
2. How does their environmental literacy compare to the average environmental literacy level of middle school youth in the U.S.?
3. How does their environmental literacy compare to the environmental literacy level of youth in a non-environmental school?

Participants

The participants of this study included a non-random sample of 6th grade students at an environmental charter school (n=34) and a non-random sample of 6th grade students at a non-environmental school as the control school (n=21). The environmental charter school participants included 15 female (44%) and 19 male (56%) students. Both schools were located in the state of Minnesota outside of two different major cities. The environmental charter school was located within a 40-acre forested habitat and found in the northern part of the state, while the non-environmental school was surrounded by farmland and was located in the southern part of Minnesota. The city where the environmental charter school was located had a different socioeconomic status than the city where the non-environmental school was located (American Psychological

Association, 2012). A total of 324 students attended the environmental charter school and 884 students attended the non-environmental school. The grade level of the participants was chosen to match the grade level of the participants from the original instrument (MSELS), which was 6th grade. The environmental charter school was chosen based on the use of EE in the curriculum and use of EE in and outside the classroom. The treatment school was an environmental charter school that used an environmental education approach based on the EIC Model™ in their school curriculum. Core subjects of math, science and writing were used for students to have applied their observations and have researched their questions that drew on each student's innate interest in nature. Teachers have shared and enhanced their knowledge of EE through the use of a school EE specialist, EE teacher trainings, and EE staff from the charter school's residential environmental learning center charter authorizer and other local resources. The EE specialist has worked closely with K-4th grade students with a focus on the use of the school forest and outdoor nature trail, while 5th and 6th grade science teachers have been responsible for the use of EE in the curriculum for these grades. The school has received much recognition for their commitment to EE.

Design

This pre-experimental posttest only static group comparison study looked at the environmental literacy (dependent variable) of 6th grade students that participated in an environmental charter school experience (independent variable). The results of this one-time test were compared with a 6th grade classroom at a non-environmental school. Both classrooms were compared with the national baseline of environmental literacy originally

found by McBeth and Volk using the MSELs.

Treatment

The treatment (independent variable) for this study was 6th grade participation in the environmental charter school. This school has been in operation as an environmental charter school for many years. The environmental charter school used the *environment as an integrated context* (EIC) in their K-6th grade curriculum. Their EE curriculum was developed with a specific focus for each grade level during their academic experience. Lesson plans have been based on site-based learning, integrated outdoor activities, and phenology (the study of seasonal changes to natural events). To aid in implementing the curriculum, the environmental charter school had 40 acres of forested land that has been used as an outdoor classroom and included a one-mile nature trail. Teachers have used the nature trail for hands-on outdoor learning experiences. Students have been encouraged to observe and find relationships between their community and the natural environment. Each grade designed their own investigations that used this outdoor classroom as well as the local community. Students at the environmental charter school have attended a 3 to 5 day field trip to a residential environmental learning center; the school's charter authorizer, to enhance the experience. While at the residential environmental learning center, students have learned about local cultural and natural history, outdoor skills, and team building through classes taught by professional environmental educators.

Instrument

The instrument that was used for this study was the Middle School Environmental Literacy Survey 2009 (MSELS 2009). The MSELS 2009 was developed by Hungerford, Volk, McBeth and Bluhm and was based off of the Middle School Environmental Literacy Instrument developed and field-tested in 1995 by Bluhm, Hungerford, McBeth and Volk (McBeth & Volk, 2010). The MSELS 2009 contained 75 items. The MSELS 2009 was designed to be administered within a 50-minute class period and to be completed within about 50 minutes (McBeth & Volk, 2010). Of the 75 questions on the MSELS 2009, the first 4 questions were demographic items. The next section contained 17 ecological knowledge multiple-choice items. Questions 22-58 were Likert-type items that asked the participant about their environmental behaviors and attitudes, based on a scale of “very true” to “very false” or a scale of “to a great extent” - “to no extent.” Lastly, questions 59-75 were issue- and action-based and asked that the participant read a short essay and answer the question that followed.

Table 1
The Environmental Literacy Sub-Domains on the MSLES

Components of Environmental Literacy	Sub-domain	Item #	Response Format
Ecological Knowledge	Ecological Knowledge	5-21	Multiple choice
Behavior	Actual Commitment	34-45	Likert-type
Environmental Affect	Verbal Commitment	22-33	Likert-type
	Environmental Sensitivity	46-56	Likert-type
	General Environmental Feelings	57-58	Likert-type
Cognitive Skills	Issue Identification	59-60 & 67	Multiple choice
	Issue Analysis	61-66	Multiple choice
	Action Planning	68-75	Multiple choice

The validity for the MSELs 2009 was “based on a comparison of elements of the instrument and the body of EE research literature, and construct validity was established using an expert panel” (McBeth & Volk, 2010, p. 58). Reliability of the MSELs 2009 was obtained using Cronbach’s alpha. The instrument produced alpha coefficients that ranged from .717 to .847 (McBeth & Volk, 2010).

Procedures

Following approval from the University's Institutional Review Board, and school permission, student assent, and parent consent the MSELs was self-administered, by the researcher, to each 6th grade classroom in the spring of 2012. The test booklet was passed out and instructions were given to participants. The participants had 50-minutes to complete the MSELs. Participants marked their responses directly in the test booklet. Responses were scored using the key provided with the MSELs. Data was entered into SPSS, and total scores were computed for each of the 8 sub-domains of the instrument, as well as an overall (adjusted) composite score and the four environmental literacy components. Adjusted scores were created through multiplication of component scores by a factor, prior to adding them together, to adjust for differing numbers of items within each sub-domain. This was in accordance with the *National Environmental Literacy Assessment Project: Year 1, National Baseline Study of Middle Grade Students Final Research Report*, where this procedure is explained in detail in terms of rationale and process (McBeth, Hungerford, Marcinkowski, Volk & Meyers, 2008).

Chapter 4

Results

The purpose of this study was to explore the effect of environmental charter school participation on the environmental literacy levels of 6th grade students. The results have been presented by research question.

1. *What is the environmental literacy level of 6th grade participants in an environmental charter school?*

The mean and standard deviation were calculated for an overall (adjusted) composite score, in addition to a mean and standard deviation for each sub-domain on the instrument: ecological knowledge; verbal commitment; actual commitment; environmental sensitivity; general environmental feelings; and environmental issues and action skills. A total of 34 completed tests were received. Environmental literacy levels were reflected from the scores on the MSELs national baseline and were split into three ranges low (24-96), moderate (97-168), and high (169-240). The average environmental literacy level of 6th grade participants in the environmental charter school was 145.50 (moderate) out of a possible 240 points (61% of the possible points). The range of overall scores was 83.55 (low) to 199.55 (high), with a standard deviation of 25.93. The environmental literacy sub-domains ranged from moderate (21-40) to high (41-60). Ecological knowledge was high (44.74); environmental affect (verbal commitment, environmental sensitivity, and general environmental feelings) was moderate (39.55); cognitive skills (action planning, issue analysis, and issue identification) was moderate (25.10); and behavior (actual commitment) was moderate (38.62). Table 2 presented the range of scores, (unadjusted) means, standard deviations and percentage of possible

points for the sub-domains.

Table 2
Environmental Charter School 6th Grade Participants' Unadjusted Scores on
Environmental Literacy Sub-Domains

Environmental Literacy Sub-domain	Component of Environmental Literacy	Range of scores	Mean	Std. Dev	Possible points (%)
Verbal Commitment	Environmental Affect	26-56	42.06	7.91	70%
Actual Commitment	Behavior	16-55	38.62	5.29	64%
Environmental Sensitivity	Environmental Affect	19-49	34.67	7.57	63%
Ecological Knowledge	Ecological Knowledge	3-17	12.68	2.55	75%
General environmental feelings	Environmental Affect	4-10	8.31	1.72	83%
Action Planning	Cognitive Skills	0-20	7.38	5.29	37%
Issue Analysis	Cognitive Skills	0-6	3.35	1.70	56%
Issue Identification	Cognitive Skills	0-3	1.00	1.04	33%

The 6th grade participants scored the highest on the sub-domain general environmental feelings (83%). Participants scored the lowest on the sub-domain of issue identification (33%) based on the percentage of points possible. These scores represented the environmental literacy level of the 6th grade participants at an environmental charter school. The following research question addressed this in greater detail, through a comparison of the scores with data from the national baseline study.

2. *How does their environmental literacy compare to the average environmental literacy level of middle school youth in the U.S.?*

The overall (adjusted) composite score on the national baseline for 6th grade

participants was 143.99 (SD=24.99) and the overall (adjusted) composite score for the environmental charter school was 145.50 (SD=25.93). The (adjusted) sub-domain scores for the environmental charter school 6th grade participants and the national average are presented in table 3. The unadjusted sub-domain scores for the national 6th grade average have been presented in table 4.

Table 3
A Comparison of Environmental Charter School 6th Grade Participants' Adjusted Environmental Literacy Sub-Domain Scores with National Average

Environmental Literacy Sub-Domains	Environmental Charter School Mean (SD)	National Average Mean
Ecological Knowledge	44.74 (9.01) (High)	39.67 (Moderate)
Environmental Affect (verbal commitment, general environmental feelings, and environmental sensitivity)	39.55 (7.31) (Moderate)	40.73 (Moderate)
Behavior (actual commitment)	38.62 (8.77) (Moderate)	38.44 (Moderate)
Cognitive Skills (action planning, issue analysis, issue identification)	25.10 (11.16) (Moderate)	25.15 (Moderate)

Table 4
National 6th Grade Averages for Environmental Literacy Sub-Domains.

Environmental Literacy Sub-domain	Range of Points Possible	Mean	SD	Percentage of possible points (%)
Verbal Commitment	12-60	43.89	8.88	73%
Actual Commitment	12-60	38.44	9.15	64%
Environmental Sensitivity	11-55	32.54	7.47	59%
Ecological Knowledge	0-17	11.24	3.26	66%
General environmental feelings	2-10	8.14	2.00	81%
Action Planning	0-20	7.25	5.44	36%
Issue Analysis	0-6	2.75	1.89	46%
Issue Identification	0-3	1.31	0.93	44%

A one-sample *t*-test was used to determine if the scores from the environmental charter school were significantly different from the national MSELs scores. There was no significant difference between overall (adjusted) environmental literacy composite score for the environmental charter school and the national average, $t(25) = .297, p = .769$. When sub-scores from the sub-domains were compared, participants at the environmental charter school scored significantly higher than the national baseline on the ecological knowledge sub-domain, $t(27) = 2.9, p = .006$. The results of the (unadjusted) sub-domain comparisons were reported in table 5.

Table 5
 A Comparison of Environmental Charter School 6th grade Participants' Environmental Literacy (unadjusted) Sub-Domain Scores with National Average

Environmental Literacy Sub-domain	Environmental Charter School Mean (SD)	National Mean (SD)	t value	df value	Significance Level (p)
Verbal Commitment	42.06 (7.91)	43.89 (8.88)	1.35	33	.186
Actual Commitment	38.62 (8.77)	38.44 (9.15)	.118	33	.907
Environmental Sensitivity	34.67 (7.57)	32.54 (7.47)	1.61	32	.116
Ecological Knowledge	12.68 (2.55)	11.24 (3.26)	2.9	27	.006
General environmental feelings	8.31 (1.72)	8.14 (2.00)	.49	25	.622
Action Planning	7.38 (5.29)	7.25 (5.44)	.146	33	.885
Issue Analysis	3.35 (1.70)	2.75 (1.89)	1.97	30	.057
Issue Identification	1.00 (1.04)	1.31 (.93)	1.61	28	.118

3. *How does their environmental literacy compare to the environmental literacy level of 6th grade youth in a non-environmental school?*

The environmental charter school results were compared with 6th grade participants from a non-environmental school within the same state. A total of 21 completed surveys were received from the non-environmental school. The non-environmental school participants included 13 female (62%) and 8 male (38%) students. When compared with the environmental charter school, the overall scores of the students in the non-environmental school were higher but not statistically significant. The non-environmental school participants had an overall (adjusted) composite score of 158.55 (66% of the possible points, SD=22.90) while the environmental charter school's overall (adjusted) composite score was 145.50 (61% of the possible points, SD=25.93). Table 6 presented the (adjusted) sub-domain scores from the environmental charter school participants and the non-environmental school. Table 7 presented a comparison of scores for each

environmental literacy sub-domain.

Table 6

A Comparison of Environmental Charter School 6th Grade Participants' Adjusted Environmental Literacy Sub-Domain Scores with Non-Environmental School

Environmental Literacy Sub-Domains	Environmental Charter School Mean (SD)	Non-Environmental School Mean (SD)
Ecological Knowledge	44.74 (9.01) (High)	41.82 (11.63) (High)
Environmental Affect (verbal commitment, general environmental feelings, and environmental sensitivity)	39.55 (7.31) (Moderate)	45.15 (4.67) (High)
Behavior (actual commitment)	38.62 (8.77) (Moderate)	43.71 (4.90) (Moderate)
Cognitive Skills (action planning, issue analysis, issue identification)	25.10 (11.16) (Moderate)	27.53 (14.13) (Moderate)

The results of the independent *t*-test indicated the difference between the overall (adjusted) environmental literacy scores was not statistically significant $t(43) = 1.89, p = .06$. When the scores of the (unadjusted) sub-domains were compared, the non-environmental school scored significantly higher than the environmental charter school on the sub-domains verbal commitment, $t(20) = 4.84, p = .001$; actual commitment, $t(20) = 4.76, p = .001$; and general environmental feelings, $t(19) = 6.43, p = .001$.

Table 7

A Comparison of 6th Grade Participants' Environment Literacy Unadjusted Sub-Domain Scores with Non-Environmental School 6th Grade Participants

Environmental Literacy Variable	Environmental Charter school Mean (SD)	Non-environmental School Mean (SD)	t value	df value	Significance Level (p)
Verbal Commitment	42.06(7.91)	48.09(5.75)	4.84	20	.001
Actual Commitment	38.62(8.77)	43.71(4.9)	4.76	20	.001
Environmental Sensitivity	34.67(7.57)	35.81(6.37)	.82	20	.422
Ecological Knowledge	12.68(2.55)	11.85(3.29)	1.12	19	.274
General environmental feelings	8.31(1.72)	9.50(.83)	6.43	19	.001
Action Planning	7.38(5.29)	9.48(5.75)	1.67	20	.110
Issue Analysis	3.35(1.70)	3.35(2.09)	.001	19	1.00
Issue Identification	1.00(1.04)	1.00(1.00)	.001	20	1.00

Summary of results

Environmental charter school participation of 6th grade students showed an environmental literacy rate (145.50) similar to the national average (143.99), and lower than the non-environmental school's environmental literacy score (158.55) on the Middle School Environmental Literacy Survey. The differences were not statistically different. When the environmental literacy (unadjusted) sub-domains were compared between the environmental charter school and the national average, the ecological knowledge sub-domain was significantly higher than the national average, $t(27)=2.9$, $p=.006$. When scores were compared with a non-environmental school, the environmental literacy level was lower for the environmental charter school participants, although not statistically significant. When the sub-scores of the (unadjusted) sub-domains were compared, the non-environmental school scored significantly higher than the environmental charter school on the sub-domains verbal commitment, $t(20)=4.84$, $p=.001$; actual commitment,

$t(20)=4.76, p=.001$; and general environmental feelings, $t(19)=6.43, p=.001$.

Chapter 5

Discussion

Summary

As it states in the introduction, environmental education's primary aim is to develop an environmentally literate citizenry (North American Association for Environmental Education, 2008). For a person to be considered environmentally literate, they must possess the knowledge, skills, behaviors, and attitudes concerning the environment (Hollweg et al., 2011a). While the scope of EE in the U.S. is much greater since its foundation, it does not yet result in widespread environmental literacy (Elder, 2003). The National Environmental Education Training Foundation (NEETF) is further calling for efforts to increase environmental literacy, specifically suggesting the need for EE for all ages (Coyle, 2005). This suggests that EE has the potential to increase environmental literacy, but that this potential has perhaps not yet been reached.

The purpose of this study is to explore the effect of environmental charter school participation on the environmental literacy levels of 6th grade students. The results are guided by the three research questions.

1. What is the environmental literacy level of 6th grade participants in an environmental charter school?
2. How does their environmental literacy compare to the average environmental literacy level of middle school youth in the U.S.?
3. How does their environmental literacy compare to the environmental literacy level of 6th grade youth in a non-environmental school?

Discussion

The first research question aims at finding out what the level of environmental literacy is for 6th grade participants at an environmental charter school. On average students scored 61% for an environmental literacy adjusted composite score of 145.50 on the MSELS. The 6th grade participants' have the highest score on the environmental literacy sub-domains: general environmental feelings (83%), ecological knowledge (75%), and verbal commitment (70%). These results parallel the assumption that students participating in an environmental school would have positive feelings and knowledge about the environment. This research question is important in finding the participants' environmental literacy level in order to compare with the results from the national MSELS. The results provide a baseline for the environmental charter school participants and are compared further in the second and third research questions.

The second research question aims at finding out how the 6th grade participants compare to other middle school youth in the United States from the national MSELS (the baseline created as a basis for comparison). As with other types of literacy, environmental literacy represents a "continuum from zero ability to advanced skills" (McBeth & Volk, 2010, p. 57). The results of this study indicate the 6th grade environmental charter school participants' scores are similar to the scores of 6th grade youth in the nation. There is no significant difference between the two overall scores. Based on these ranges the environmental charter school has a moderate environmental literacy level on the MSELS (145.50). The environmental literacy level of the environmental charter school is similar to the moderate environmental literacy level of

the national baseline (143.99). It is important to note that participants in the national study include participants in environmental-based schools. This may explain in part why environmental charter school participants' scores are not significantly different from the national average.

When the environmental literacy sub-domains are compared, the environmental charter school participants score significantly higher on the ecological knowledge sub-domain than the national average. Ecological knowledge questions on the MSELs are multiple choice and ask students to identify the correct response to each ecological knowledge based question. The ecological knowledge sub-domain is part of the ecological knowledge component on the MSELs. The ecological knowledge skill is the knowledge of foundational ecological concepts and is a necessary component of environmental literacy (Elder, 2003). Questions ask participants to choose a response that correctly answers each question. Twenty-eight participants responded to the ecological knowledge multiple choice answer items receiving a score ranging from 9 (lowest)-17 (highest) out of a total possible score of 17. The (unadjusted) mean score on the ecological knowledge sub-domain is 12.68 (75% of the possible points).

The environmental charter school uses *environment as an integrating context* (EIC model™) in their curriculum. Each grade designs its own investigations using the outdoor classroom and local community to learn from the relationships between the community and the natural environment. Because the environmental charter school uses the EIC model™ in their curriculum, participants will be applying their ecological knowledge within the integrated-interdisciplinary instruction approach and can explain

the reason for their high ecological knowledge. The environmental charter school aims at connecting their student's academics and learning to the natural world. Their curriculum is based on the EIC model™, which integrates the environment into their school subjects. Therefore, participants should have basic knowledge about the environment. Ecological knowledge is one component of environmental literacy. While ecological knowledge is an important component of environmental literacy, it alone does not produce an environmentally literate citizenry (Hungerford & Volk, 1990). There is some research to suggest that an EIC-like approach, where the primary emphasis is on core academic subject improvement, may be less effective in improving environmental outcomes (Ernst & Theimer, 2011). Thus, further research is needed to better understand why scores are higher in this domain only, in spite of the use of this EIC approach.

The third research question aims at finding out how the environmental charter school's environmental literacy score compares with students from a non-environmental school. Although the results of the independent *t*-test are not statistically different, the non-environmental school has an environmental literacy level higher than the environmental charter school participants' environmental literacy level. When comparing the Minnesota Comprehensive Assessment (MCA) scores from the last five years, the non-environmental school, on average, scores higher than the environmental charter school in reading. For the past 5-years, the non-environmental school has an average of 79% in reading and the environmental charter school has an average of 76% in reading for their 6th grade students on the MCA. For the 2010-2011 school year the environmental charter school's average is 68% in reading for their 6th grade students. For

the 2010-2011 school year the non-environmental school's average is 85% in reading. The state average is 75% in reading for 6th grade students during the 2010-2011 school year.

The amount of reading required for the test may explain why the environmental charter school participants did not score significantly higher across the sub-domains than the participants at the non-environmental school. In hindsight, because of these different reading levels, the school selected for the non-environmental comparison school, is not such a good comparison. On the other hand, the sub-domains where there are significant differences (verbal commitment, actual commitment, and general environmental feelings) are not the most reading intensive areas, suggesting that reading skill may not account for the difference. Thus, future research may consider the role of reading level, and/or consider matching treatment and control comparisons in reading level.

Both schools were located outside of a major city in Minnesota and are tuition-free and open to all students, however the environmental charter school does require an enrollment application. Although there is an enrollment application, attendance at the environmental charter school is primarily a function of geographic location, as there are no other nearby public school options. The city for the non-environmental school on the 2010 census has 96% percent high school graduates, a median household income of \$63,934 and 8% of residents below the poverty line. In the city where the environmental charter school is located, the percent of high school graduates on the 2010 census is 92%; the median household income is \$41,092 and 20% of residents below the poverty line. The state of Minnesota's percent of high school graduates for the 2010 census is 91%

with a median household income of \$57,243, and 10% of its residents below the poverty line (United States Department of Commerce, 2010). The location of the environmental charter school seems to have a lower socioeconomic status than the non-environmental school and could be a factor that affects scores on the MSELs. This may be an important difference to note as, children from households and communities with low socioeconomic status (SES) may develop academic skills at a slower rate than children from higher SES households and communities (American Psychological Association, 2012). Schools located in communities with low SES often have fewer resources and can affect students' academic progress (American Psychological Association, 2012).

Of the 75 items on the MSELs, 3 are short essay items asking the participant to read a short essay that focuses on an environmental issue. The participant chooses a response that best identifies the environmental issue in the short essay. These items test participant's cognitive skills in identifying environmental issues. The North American Association for Environmental Education (NAAEE) defines environmental issues as real-life environmental problems with differing viewpoints (NAAEE, 2010). Environmental literacy includes the ability to "define, learn about, evaluate and act on environmental issues" (NAAEE, 2010, p. 6). Therefore, the ability to identify environmental issues is an important component of environmental literacy. The difficulty of these items is reflected in both groups overall score in the issue identification sub-domain.

Implications for EE

The ecological knowledge sub-domain has a higher score for the environmental charter school participants than for the national baseline. This sub-domain requires participants to correctly respond to ecological knowledge questions on the MSELs. A high overall score in this sub-domain can mean that EE is succeeding in understanding foundational ecological concepts. Since ecological knowledge is only one component of environmental literacy one must possess a combination of cognitive, affective and behavioral components to be considered environmentally literate; it is important for students to have these skills (Hollweg et al., 2011a). The environmental charter school uses the *EIC* model™ in their curriculum, which includes an integrated-interdisciplinary component that provides students opportunities to explore connections between core subject areas to develop a comprehensive understanding of natural and social systems. This opportunity encourages students to use their cognitive skills, problem-solving skills, and creative-thinking skills (Lieberman, 2005). But in spite of this focus, ecological knowledge is the only skill resulting in a rating of high. Thus, EE practitioners may need to allow for more practice in developing student's ecological knowledge to make sound ecological decisions to further the development of environmental affect, behavior and cognitive skills.

In addition to focusing attention onto the development of environmental literacy components, the effect of EE on environmental literacy needs more attention. With an increase in environmental issues that will face the nation's youth, being environmentally literate is critical.

Further research considerations

The need for determining the effect of EE on environmental literacy is great. The scope for this study does not allow for gauging the effectiveness of environmental charter schools, nor EE overall. More research with multiple schools and more rigorous design is needed.

Results from this study, although not statistically significant, show that the environmental charter school participants did not perform as well as the non-environmental school, but are similar in score with the national baseline. More research is needed to determine why this is the case. Administering assessments to environmental based schools and programs can add to existing results in identifying where environmental schools fall in comparison to the national baseline.

Another approach for further research is an environmental literacy instrument that recognizes all learning styles. Because the current instrument requires so much reading, future research might explore how to assess environmental literacy levels in ways that are not so reading intensive.

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