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Désirée Heyns

December 2014

# ECOLOGICAL KNOWLEDGE AND VERBAL ENVIRONMENTAL COMMITMENT OF AFRICAN-AMERICAN MIDDLE SCHOOL STUDENTS IN A SUBURBAN TEXAS SCHOOL

A Dissertation Presented to the
Faculty of the College of Education
University of Houston

In Partial Fulfillment
of the Requirements for the Degree

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## Abstract

Today's kindergarteners will be retiring in the year 2075. We have no idea what the world will look in five years, much less 60 years, and the idea of a changing world can be daunting (Kellner, 2000). At the same time, today's youth will be assuming leadership roles with the responsibility of environmental stewardship and the task of implementing actions for a sustainable world. The future is uncertain, however, preparing our children for a life focused on balancing the environment while sustaining a growing human population is a critical concern. These issues will require our youth to effectively deal with challenges in the social, economic and political arenas on local, national and global levels (Smith & Sobel, 2010).

To address the many uncertainties, and relinquish unanticipated or unintended consequences, students today will need more than superficial knowledge or awareness of disconnected environmental issues (ELC, 2008). Our vision of global sustainability will involve a true understanding of the balance between human needs and our natural resources. To carry out these tasks and manage the quality of the environment, our children must be an environmentally literate citizenry who can identify, solve, and prevent environmental issues collectively. However, there is great concern that an informed public with the necessary skills to address environmental issues at their root will not be prepared for the task (Hollweg et al., 2011).

Science education reform proponents explicitly put forward the idea that all students, regardless of culture, gender, race, or socioeconomic status, are capable of understanding and doing science (Barnett et al., 2006). However, very little research has been published on the subject of African American middle school students and environmental literacy. The lack of empirical information about young people's environmental views will require further examination.

The purpose of this study was to determine the extent of *ecological knowledge and verbal commitment* among a group of sixth, seventh and eighth grade African American students in a suburban Texas middle school. The Middle School Environmental Literacy Survey *(MSELS)* was used to collect data (Hungerford et al., 2005). All statistical analyses were performed using IBM SPSS Statistics 22.0 (SPSS Inc., Chicago, IL). The mean scores of the sample population were compared to data collected by the developers of the instrument using an ethnically diverse population in a national setting (McBeth, Hungerford, Marcinkowski, Volk, & Cifranick, 2011). Additionally, two secondary analyses were conducted. First, an independent samples t-test was conducted to determine if gender affected the scores. Second, a one-way between-groups analysis of variance (ANOVA) was conducted to explore the impact of grade differences on both components of environmental literacy.

For the ecological knowledge component, the survey results indicate the seventh grade mean score ($M$=13.18) from this research outscored the seventh grade mean ($M$=11.89) from the national scores by 1.29 points, a difference of 7 percent, indicating the suburban seventh grade students in Texas have more ecological knowledge than the national average. The national mean data indicate the sixth and eighth grade students

outscored the students from this sample by 1.49 and 1.18 points respectfully. For verbal commitment, the national data outscored the study sample by less than one point across all three grades in their willingness to commit to pro-environmental behavior. However, the 12-item measure overall mean scores from sixth, seventh and eighth grades ($M$=42.98) from this study outscored the eighth grade ($M$=42.89) national data.

When composite scores were calculated on high, moderate and low levels of environmental literacy, *Knowledge* domain data indicates the seventh grade students have a high level of ecological knowledge (46.51 out of 60), but the sixth (35.01 out of 60) and eighth (38.82 out of 60) grades fall into the upper moderate levels of the domain. When sixth, seventh, and eighth grade scores were combined, the composite score from this sample scored just under a high level of knowledge (39.84 out of 60). For the *Environmental Affect* domain (one-half the total points), the composite score for sixth grade (22.19) was highest, followed by the eighth (21.05), then seventh (20.87) grade students. When compared to the national composite scores for this domain (McBeth et al., 2011), all three grades, sixth (22.63), seventh (21.67), and eighth (21.41) were slightly higher than this sample.

The analysis of gender returned different results. Gender did not appear to play a role in either component of environmental literacy. The results from a one way analysis of variance on *How You Think About the Environment* (verbal commitment) indicate more variance exists within groups than between groups ($F$ = 2.95, $df$ = 2, p > .05). The data indicate no statistically significant difference among the mean scores of the three groups from the population sample. In calculating the effect size, Eta squared = .02, which is considered small.

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# Chapter I

# Introduction

## Statement of the Problem

In spite of our world's enormous and continually growing population, which reached 7 billion as of October 2011, and a projected 9 billion by 2050, everything and everyone is highly connected (Population Reference Bureau [PRB], 2014). With such connections in mind, the pressures caused by our interactions are unlikely to abate. From the time man began domesticating plants and animals for survival and molding ecosystems for the profit of human societies, we have altered our natural surroundings (Tohill, 2011). Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history (Millennium Ecosystem Assessment, 2005a). As our population and demand for goods increase, a growing conflict develops between continued economic development and the maintenance of unspoiled ecosystems (Bentez, 2005).

As humans exploit resources at unprecedented levels, the cost of ecosystem degradation is huge. There is now a plethora of research to support the notion that human activities could cause the transformation of our environment – thus, polluting the very elements upon which all life depends, changing the makeup of Earth's surface and atmosphere, and even causing many species to go extinct (Warrick, 1998). The National Oceanic and Atmospheric Administration (NOAA) (2009), confirms the considerable amount of environmental damage caused by pollution from industrialization and urbanization, and the relationship of industrialization and pollution to the overall survival of ecosystems. Toxic discharges can adversely impact the living organisms in an

ecosystem by weakening them, affecting their ability to carry out essential biological functions, or even killing them outright. It is therefore undeniable that our activities are changing the equilibrium of nature; and if not appropriately addressed, may result in permanent transformation of our environment (Bentez, 2005).

Fortunately, humans have enormous potential as change agents and hold the power to change current practices and safeguard the future of our local, national, and global environments. While Mother Nature has exhibited a measure of resilience to our historically destructive interaction with the environment, the current trajectory of human society suggests irreversible environmental degradation and changing climatic conditions (Tohill, 2011). Repairing the damage is within our reach, but only if the necessary steps are taken. While these concerns become more complex, more difficult to manage, and more significant in our environmental future, the solution rests to a large extent with citizens rather than scientists and politicians (Stapp et al., 1969).

Society views environmental education as a panacea for the problems we face today (Blewitt, 2005). Shared ideologies and a population with conceptual understanding of the human-environment interaction will ensure the success of a sustainable future (Grant, 1997). Orr (2002) claims only those equipped to discern and think critically can understand the magnitude of the events unfolding before our eyes, and make choices that will create a decent and humane future. He insists, "This is *the* challenge of education" (p. 9); one which requires an understanding of the issues related to human behavior and our social milieu. A viable strategy for raising the level of environmental literacy and related issues is necessary to achieve the long-term goals of an environmentally literate society (Braus, 1995; Coyle, 2005; Palmer, 1998; Smyth, 2005).

Stapp et al. (1969) found that a strong understanding of how natural resources are used requires knowledge of the social, economic and political processes that govern their utilization. In addition to understanding the aspects of the biophysical environment, citizens need to know how to work toward solutions through laws, policies, resource managements, and public institutions. Stapp claims, not only are citizens responsible for solutions to the problems, but the governments which represent them are accountable as well. Orr (2002) tells us that the world is coming apart at the seams, and only those citizens equipped with the ability to think critically and understand the magnitude of the problems can create a decent and humane future. Therefore, Orr (1992) advised taking a holistic approach when perceiving and interpreting the relative health of environmental systems and taking appropriate action to sustain those systems.

According to the National Environmental Education and Training Foundation (NEETF) (2000) and the North American Association for Environmental Education (NAAEE) (1998), environment-based education creates high-performing schools and students. The U.S. Department of Education (2014) recently released its draft called the Environmental Justice (EJ) strategy committed to meeting the goals of Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (Environmental Protection Agency [EPA], 1994). The Executive Order is centered on low-income neighborhoods, communities of color, and tribal areas that disproportionately bear environmental burdens. These hazards worsen health disparities, resulting in increased numbers of students missing school due to complications of asthma for example. They also reduce opportunities for sustainable education, energy efficient classrooms and environmental literacy.

Additionally, today's children have fewer opportunities to experience nature (Louv, 2005). In particular, minority children who are often reared in suburban neighborhoods have little interaction with nature; therefore, this dearth of experience may have a negative impact on their knowledge of and attitude toward the environment (Bullard, 2006; Flannery & Whiting, 2003). Science education reform proponents explicitly put forward the idea that all students, regardless of culture, gender, race, or socioeconomic status, are capable of understanding and doing science (Barnett, et al., 2006). These variables, and many others, directly impact the number of minorities attracted to the environmental field.

Consequently, the primary challenge ahead lies in raising the level of environmental literacy of *all* American citizens, as well as analyzing the factors that will influence the achievement of each successive generation (NEEAC, 2005). Research conducted by Sward & Marcinkowski (2001) found that (a) exposure to outdoor learning opportunities; (b) opportunities to observe and conduct analysis of environmental problems; and (c) frequent contact with role models are all significant doorways to environmental careers. Unfortunately, minority representation in these fields is discouraging.

The National Science Foundation (2003) released alarming statistics that African Americans only make up about 3% of science professional positions (Coyle, 2005), and states where minorities are enrolled in college STEM programs fail to graduate between two-thirds and three-fourths of their African-American students . Research connects these outcomes to the lack of exposure to science related opportunities in a K-12 setting (e.g., science fairs, field trips, and classes) and shortage of supportive role

models/mentors (QEM, 2010). The State Education and Environment Roundtable (SEER, 2000) believe we need to re-vision environment-based education in order to increase cultural and social diversity in the environmental management field (Coyle, 2005). In addition, new studies show a significant boost in standardized test scores when environment-based education programs are in place (Coyle, 2005).

Researchers from North Carolina State University tested the environmental literacy among sixth and eighth grade students in North Carolina schools. They found that middle school environmental education programs conducted in an outdoor learning environment helped minority students close the environmental literacy gap. From an ecological viewpoint, the minority students in this study not only improved ecological literacy, but also demonstrated an increase in cognitive skills when exposed to outdoor learning opportunities (Stevenson, 2013). Although more research is needed, environmentally rich programs represent significant opportunities in attracting a large number of minorities to professional science, engineering and environmental fields.

The theoretical foundations and framework of environmental education emphasize the inclusiveness of a diverse community of multicultural learners. A culturally diverse nation depends on several basic principles that surround environmental literacy: continuous learning from responsible citizens that will increase knowledge and awareness about the environment; skills necessary to address the challenges; attitudes, motivations, and commitments to make informed decisions; and the ability to take the necessary actions to bring about changes (NEEAC, 1996). When citizens unify in a common goal, and nurture these conditions, a competent workforce will be prepared for

the challenges of a 21st Century world (National Council for Science and the Environment, 2008).

Few issues are likely to be more important. Only when we embrace multicultural systems with social, economic and political support can we modify and eradicate human-caused environmental destruction. In order to face these challenges, the students of today will need more than superficial knowledge or awareness of disconnected environmental issues (Elder, 2007). They need to develop and transfer cognitive skills that will allow them to cope with ecological problems with a more sustainable approach (McKeown, Hopkins, Rizzi, & Chrystalbridge, 2002).

**Purpose of the Study**

In 2009, the African American student population in our nation's public schools was more than 8.2 million (NEA, 2009). Yet, little social science research has focused on the extent of environmental literacy among this group. Data identifying the level of ecological knowledge or verbal commitment to pro-environmental behavior is also lacking from the body of knowledge in this field. The goal of this study, therefore, was to collect empirical data on African American students in grades six, seven and eight in a suburban setting using the Middle School Environmental Literacy Survey *(MSELS).* This instrument has been proven both valid and reliable in measuring critical components of environmental literacy related to four specific domains (McBeth et al., 2008). The four domains include: Ecological Knowledge, Environmental Affect, Cognitive Skills, and Behavior. Included in the four domains are components that help determine the extent of environmental literacy. These components include: (a) ecological knowledge; (b) verbal

commitment; (c) environmental sensitivity; (d) actual commitment; (e) issue identification and issue analysis skills; and (f) action planning.

For purposes of this study, and conditions beyond my control, only the first three sections of the survey were administered and completed by the sample population. Section I collected demographic data on participants; section II tested the ecological content knowledge of participants; and section III judged the willingness of participant to engage in pro-environmental responsible behavior. Together, *ecological knowledge and verbal commitment* data provided a better understanding of the degree of environmental literacy the students possess.

**Research Questions**

Four broad research questions guided the design of this study:

1. What is the extent of ecological knowledge of sixth, seventh and eighth grade African American students in a suburban setting?
2. To what extent do sixth, seventh and eighth grade African American students in a suburban setting verbally commit to positive-environmental behavior?
3. How does the environmental literacy component *ecological knowledge* of sixth, seventh and eighth students in this study compare to the environmental literacy component *ecological knowledge* of sixth, seventh and eighth grade students across the U.S.?
4. How does the environmental literacy component *verbal commitment* of sixth, seventh and eighth students in this study compare to the environmental literacy component *verbal commitment* of sixth, seventh and eighth grade students across the U.S.?

**Justification the Study**

There exists a lack of evidence related to the status of ecological knowledge or positive-environmental verbal commitment among African American middle-school students. The U.S. Environmental Protection Agency's (EPA) National Environmental Education Advisory Council (NEEAC) (1996) has expressed valid concern for more information and the need for research in this area. On November 16, 1990, President George H. W. Bush signed into law the National Environmental Education Act (P.L. 101-619). The Act presented the EPA its first Congressional mandate to strengthen and expand environmental education as an integral part of its mission to protect the environment. In 2005, the NEEAC tendered its Report to Congress entitled, *Setting the Standard, Measuring Results, and Celebrating Successes.* The report describes the current status of environmental education in the U.S., discusses EPA's progress in implementing the National Environmental Education Act, and recommends further steps that Congress and various stakeholders can take to strengthen environmental education nationwide. An important request put forth by the Council was that "a framework be developed and tools created for measuring the effectiveness of environmental education" (p. 3). The results from this study provide valuable relevant information and a unique opportunity for the Office of Environmental Education (OEE) to demonstrate the impact that EPA's funding made in the effort to increase environmental literacy.

Empirical data collected in this research provides a contribution to effectively address the academic achievement of *ecological knowledge and verbal commitment* of African American students in the sixth, seventh and eighth grades. This information can be used to assess program effectiveness in the hope of raising environmental literacy

across the nation. This project also addressed the National Oceanic and Atmospheric Administration's (NOAA) (2009) vision to incorporate environmental literacy into its research strategies as noted in their Education Strategic Plan 2009-2029. Goal 1 of the plan is to establish "an environmentally literate public supported by a continuum of lifelong formal and informal education and outreach opportunities in ocean, coastal, Great Lakes, weather, and climate sciences." (p. 9). The following statement was also noted with this plan: "For NOAA to achieve its strategic vision, an environmentally literate and engaged public must be fostered" (p. 9). The data generated by this project may have a direct impact on the design of NOAA's educational programming and aid in the agency's success in meeting its academic objectives.

Data from this research can identify factors that contribute to the disparities across variables measured by the *MSELS* (See Appendix A). The data generated in this study may also benefit analyses within a cultural context with future national ethnic/cultural data. Finally, these data can assist in the design of framework for future curricula by helping to establish a more focused paradigm different from the mechanistic curriculum now practiced throughout our public schools.

**Key Terms**

*Ecological knowledge* refers to the knowledge of major ecological concepts. It also refers to a knowledge and understanding of how natural systems work, as well as a knowledge of how natural systems interface with social systems (Volk & McBeth, 1997, p. 74).

The term *environmental education* has been associated with various definitions since its initial usage in 1977. The North American Association for Environmental

Education (NAAEE) published guidelines that emphasize in-depth understandings based on accurate information, critical thinking and research skills, as well as taking action to enhance the environment (NAAEE, 1997). Additionally, NAAEE states that effective environmental education programs should include learning related to the following areas: environmental appreciation, ecological knowledge, sociopolitical knowledge, knowledge of environmental issues, skill development, sense of responsibility, and knowledge of action strategies. The United Nations Educational Scientific and Cultural Organization (UNESCO) (1977), and the EPA (1992) define it as a learning process that increases people's knowledge and awareness about the environment, ultimately leading to responsible behavior which should increase critical thinking, problem solving, and effective decision-making skills.

Roth (1992) defined *environmental literacy* as going several steps beyond the acquisition of knowledge and awareness. This particular researcher is also of the opinion that environmental literacy should be defined in terms of *observable behaviors*. Specifically, Roth states, "People should be able to demonstrate what they have learned — their knowledge of key concepts, skills acquired, disposition toward issues, and the like" (p.1). He further referred to environmental literacy as the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to sustain the function of those systems.

*Formal education* is learning within a structured education system in which children or adults are required to demonstrate proficiency (NOAA, 2009).

*Informal education* is learning resulting from life experiences outside the organized classroom. It is not structured (in terms of learning objectives, learning time or

learning support), and typically does not lead to certification. Learning may be intentional but in most cases it is non-intentional (McKeown et al., 2002).

*Life- long learning* is all learning activity, formal and informal, undertaken throughout life, with the aim of enhancing knowledge, skills, and competencies from a personal, civic, social, and/or employment-related perspective (NOAA, 2009).

A *middle-school student* is defined as an individual enrolled in intermediate grades between elementary school and high school, encompassing grades five or six through nine (Marcinkowski, Volk, & Hungerford, 1990).

According to the definition of the Educational Resources Information Center (ERIC) of the U.S. Department of Education, *non-formal education* is organized education without formal schooling or institutionalization, in which knowledge, skills, and values are taught by relatives, peers, or other community members (ERIC, 1999). This notion includes any planned and organized education outside school, such as workshops and seminars conducted by NGOs (non-governmental organizations), communities and businesses.

A district is classified as major *suburban* if: (a) it does not meet the criteria for classification as major urban; (b) it is contiguous to a major urban district; and (c) its enrollment is at least 3 percent that of the contiguous major urban district or at least 4,500 students.

**Organization of Dissertation**

This paper presents a study on *ecological knowledge and verbal commitment* of African-American middle school students in grades six, seven and eight in a suburban setting. In exploring the fields of environmental education, environmental literacy, and

ecology, numerous studies were identified describing the framework of variables that compile these overlapping domains. These terms have been used throughout this research paper and the components which make up the framework of environmental literacy are discussed more in detail.

This study employs quantitative data collection using the first three sections of the Middle School Environmental Literacy Survey (*MSELS*) (Hungerford et al, 2005). The students responded to survey questions regarding their knowledge and willingness to commit to pro-environmental behavior regarding the environment. The paper is organized into five chapters beginning with Chapter One, an introduction to the study. This is followed by Chapter Two, a review of literature pertaining to the data collection principles. Chapter Three describes the methodology used in this research, and following this is Chapter Four, a summary of the results. Finally, Chapter Five presents a discussion of the findings and the conclusions drawn from the data collection process.

# Chapter II

# Literature Review

## Introduction

Earth's ecological systems provide humanity with numerous benefits including water filtration, soil stabilization, nutrient cycles, crop pollination and waste decomposition (McBride, 2011). Problems as diverse as disease transmission and global climate change have benefited substantially from advances in ecology (Palmer et al., 2004). The relationship between humans and nature is complex in that the environment affects the quality of human life and conversely human actions affect the quality of the environment. Human interactions with nature have had a tremendous impact on our natural resources, just as the environment has had an immense impact on humanity itself (Millennium Ecosystem Assessment, 2005b). At present, more than 7.2 billion people are using (and often knowingly or unknowingly abusing) the earth's natural resources (Braus & Wood, 1993). As human societies evolve, and become more complex and technologically advanced, our pressures on the global environment and natural resources continue to change and impact earth's biodiversity at global levels (Coyle, 2005). In the last 100 years human activity has caused between 50 and 1000 times more extinctions than would have happened due to natural processes (Millennium Ecosystem Assessment, 2005b).

To combat this trend, we must consider the consequences of our actions and collectively work toward achieving a dynamic equilibrium between the complex qualities of life and a sustainable environment (Hungerford, Peyton, & Wilke, 1980). Thus, to maintain sustainable ecosystems while meeting the socioeconomic, political and cultural

needs of current and future generations**,** society must work together as a nation (Szaro, Sexton, & Malone, 1998). Collectively, the shared vision of and efforts toward attaining a sustainable ecological future will allow society to successfully mitigate environmental issues and make informed decisions. These decisions will require a clear understanding at all levels—locally, nationally, and globally—that humans are an inseparable part of their biophysical surroundings and capable of altering their interrelationships (Stapp et al., 1969).

Although humans affect virtually all of the earth's processes many question our adequate knowledge of human-environment interactions (Scholz, 2011). A report from the Ecological Visions Committee to the Governing Board of the Ecological Society of America (ESA) states, "Environmental issues will define the 21st Century, as will a world with a large human population and ecosystems that are increasingly shaped by human intervention" (Palmer et al., 2004, p. 2). The ESA argues that the public must be educated in processes that balance man's relationship with his surroundings. Palmer emphasized that ecological knowledge must be the central focus to achieving a world in which human populations exist within sustainable ecological systems. A study by Hines, Hungerford, and Tomera (as cited by Asch & Shore, 1975; Bamberg & Moser, 2007; Klinger, 1980; Ramsey et al., 1981) found that an individual must be cognizant of the existence of environmental problems, and possess knowledge on effective courses of action before they "intentionally" act pro-environmentally. Another critical component emphasized by Bardwell and Tudor (1994) is that students must identify personal priorities and respect others before they can assume the responsibility and problems

associated with environment education's mission to actively participate in issue resolution.

As research has shown, it is vital that citizens be knowledgeable concerning the environment and the interrelationships in order to be effective in working toward a shared solution to environmental problems (Stapp et al., 1969). These notions are central to the concept of environmental literacy. Berkowitz, Ford, and Brewer (2005) point to ecological understanding and a working knowledge of ecological processes as integral components of environmental literacy. Moreover, the in-depth and conscious study of the relationship between society and the environment are essential in leading an informed public to be stewards of the planet and contributing to the overall sustainability of their goals (UN Global Compact, 2010). Orr (as cited in Roodman, 1999) stated, "To become ecologically literate, students need to experience education less as an exercise in taking dictation than as an ongoing dialogue, in which ideas are formulated, tested against everyday experiences, and revised" (p.186).

It is important we set forth the agenda of teaching students to be environmentally literate so that students understand how human-engineered and natural systems are connected and how they themselves impact the environment. The United Nations Environment Programme (UNEP) (2014) states that healthy, educated and self-determining human populations can deliver a workforce for vibrant economies. They also add that knowledge, skills, attitude, and responsible behavior represent social capital; and that investing in education and knowledge for sustainable development expands our ability to adapt and identify responsible solutions.

The need to continuously reinforce environmental learning and expectations is important to emphasize. Hungerford and Volk (2005) point out educators cannot assume one course or one unit of training will effectively change student behavior. They report a study completed by Ramsey et al. (1981) on environmental behavior of eighth grade students in which students' environmental behaviors were found to erode after a three year period without instructional reinforcement. He concluded that intervention treatments were needed to maintain students' original level of involvement. Based on this and other studies, Hungerford and Volk claim it is imperative that students receive in-depth pro-environmental reinforcement over a substantial period of time.

Additionally, national assessments indicate the American public is unprepared and lacks the basic knowledge to respond to the major environmental challenges we face in the 21st century (Coyle, 2005). A recent poll indicated that only 49% of U.S. residents agree that the earth is getting warmer because of human activity, and only 32% agree that humans and other living things have evolved due to natural processes (Pew Research Center for People and the Press, 2009). International science assessments found that American students were out performed by many European and Asian countries (Gonzales et al., 2000) and, in particular, scored poorly on the ecology portions (Institute of Education Science, 2006). The National Center of Education Statistics Trends in International Mathematics and Science Study (TIMSS) reported only 38% of eighth grade students passing, far behind the students from England, Japan and Russia (NCES, 2007). These and other findings suggest that, in the U.S., our knowledge about the environment and the natural world is too low to be effective in achieving our goals with

regard to our increasing environmental responsibilities in the coming years (Coyle, 2005; Groffman et al., 2010; Jordan et al., 2009; Miller, 2002).

This chapter will begin by addressing the origin and various understandings of the term literacy. Followed by an understanding of the term ecology, its origin and how the term ecological knowledge is used under the environmental literacy umbrella. The next section provides details on environmental education, definitions, and historical origin, as well as the framework of goals, objectives and guiding principles and their hierarchical approach associated with environmental literacy. Next, two historical founding documents will be discussed as they relate to the framework and overall goal of environmental education, The Belgrade Charter, and the Tbilisi Declaration. Lastly, this chapter will delve into environmental literacy – specifically, the definitions, components, and details of the different overlapping frameworks that various scholars and organizations have devised over the past few decades.

**Literacy Defined**

Defining literacy in a changing world is not easy. According to Michaels and O'Connor (1990), the word *literacy* did not exist until the late 19th century, and is predated by several hundred years by the word illiteracy. From its inception, the term *literacy* has been used to reference someone with the ability to read and write (Roth, 1992). In the mid-eighteenth century, only 10% of the world's population could read or write (UNESCO, 2005). The term literacy means the ability to read and write (The Concise Oxford Dictionary, 1964, p 709) and the ability to use language proficiently (Merriam Webster, n.d.). It has also come to mean competence or knowledge in a specified field (Oxford English Dictionary, n.d.).

In regards to this last definition of the term, literacy is more than technical skills (e.g. learning the alphabet, forming letters, and decoding print), it also requires mastery of certain behaviors, expectations, and attitudes, in addition to specific skills related to written language (Kress, 2003). As recently as 100 years ago, simply marking an "X" on a legal document was evidence of literacy (History of Literacy, 2008). Just as the words *equality, freedom* and *justice* were representative of human rights, *literacy* came to represent a *value* in conjunction with government policies. In the years following the Civil War, Southern legislators tested potential citizens for literacy on U.S. political history as a prerequisite to voting. This requirement kept many rural and poor adult citizens from voting (NAACP, 2009). Society began to see illiteracy as a social ill and literacy as beneficial to cultural contexts and the advancement of society as a whole (Michaels & O'Connor, 1990; Carl, 2009). It wasn't until The Voters Act of 1965, however, that such racially discriminating voting practices were prohibited. The Voters Act contained numerous provisions regulating the administration of elections, specifically outlawing literacy tests and any devices that were used to discriminate against racial minorities.

Literacy during the 1960s identified closely with the concept of the "3R's" (i.e., reading, writing, and arithmetic), which were considered essential in the preparation of a work force that could express ideas, understand basic instructions, exchange written communication, and perform simple office functions (Kellner, 2000). It was a few years later, in the 1970s, that many scholars and social psychologists argued for a more useful concept of the word. They claimed the 3R's linked the word too closely to school-based

writing and caused serious limitations in accounts of literacy—predominantly when associated with improving faculties of reasoning (Scribner& Cole, 1978; Olson, 1977).

In practice, one's literacy skills are determined by a complex overlap of motivation and educational opportunity. This relationship in itself is influenced by a broader social context where language practices have played an important role in the development of literate communities (UNESO, 2005).

Kolb and Fry (1975) claim *acquired information* can be forgotten, whereas genuine learning is existentially momentous and quite unforgettable. Literacy is an active phenomenon, deeply linked to personal and cultural identity. Its power lies not in a received ability to read and write, but rather in an individual's capacity to put those skills to work in shaping the course of his or her own life (EDC, 2011). Although literacy is a term that originally referred to reading and writing, it has evolved considerably in scope and discourse (Roth, 1992). The concept of literacy can be further complicated with its inherently plural notions embedded in social settings with a variety of adjectives—computer literacy, science literacy, workplace literacy, school literacy, bureaucratic literacy, bilingual literacy, and so on (Michaels & Collins, 1984; 21st Century Schools, 2010).

**Ecology: Historical Origin**

Ecology has a complex origin, largely due to its diverse interdisciplinary nature (Egerton, 2001). Scholars have traced our experiences and innumerable interactions with natural phenomena as far back as pre-literate human societies, where innumerable interactions with the natural environment were necessary for survival (Magner, 2002). People passed down their knowledge of hunting, fishing, animal behavior, struggles

against disease, and benefits from plants such as food and medicine from generation to generation by word of mouth and cultural rituals (Grant, 2007). These primitive understandings eventually developed into a more formalized inquiry about nature's workings termed *natural philosophy*, the precursor of natural science.

The history of natural science studies can be traced back to the 4th Century BC in ancient Greece (Ramalay, 1940). Aristotle and his successor Theophrastus paid close attention the natural world (Grant, 2007). Their investigations on living things are central to modern study of natural phenomena, suggesting they may have been the first *natural scientists* (Balme, 1991; Reid, 2009). Aristotle's influential work in this area went unchallenged, idling and unchanged for over two millennia (McLeisch, 1999).

It wasn't until the mid-18th century when Ecology began to take on more recognition with Swedish naturalist Carl Linnaeus' organized system of nature (Reid, 2009). His book, *Systema Naturae* (1731), attracted much attention because of the changes made in the biological classification system, and his introduction of *Linnaean taxonomy* which laid the groundwork for modern ecology (Ramalay, 1940). Another prominent naturalist of the era, and appropriately labeled *18th century super scientist* by President Thomas Jefferson (Mehler, 2013), was Alexander von Humboldt (1769-1859). Humboldt was a Prussian geographer, whose scientific contributions stemmed from all disciplines of science (Brinton 1890, p. 332.). In his extensive travels (24,000 miles) Humboldt discovered many species of plants and animals (e.g., electric eel), laying the foundation for the field of biogeography (Brendel, 1879, p.759). His quantative works on botanical geography were chronicled in a treatise covering a 21 year period (Chisholm,

1911). Humboldt's invaluable contributions to scientific progress led to his belief in the unity of science, nature and mankind (Botting, 1973).

The 19th century was inundated with influences from prominent figures such as German zoologist and ecology pioneer, Karl Möbius (1825-1908). Möbius was the first to describe the interactions of organisms (oyster bank) in a habitat with a term he coined as *biocoenosis* (ecosystems) (Allaby, 2009). Others dominant in the field were Stephen Forbes (1844-1930), who believed that ecological knowledge was essential for human well-being, and Eugenius Warming (1821-1924), whose research with plant geography, helped give rise to ecology as a discipline (Coleman, 1986). British naturalist and co-author of *Origin of the Species* (1858), Alfred Russel Wallace (1823-1913), is referred to as the *father of biogeography,* and is known for his unconventional ideas and contributions to the theory of evolution. Because of his significant connections with Darwin, he is also credited as a co-discoverer of natural selection (Smith, 1972).

When English naturalist and geologist Charles Darwin (1809-1882) began his famous expedition on the HMS Beagle, the word ecology did not exist (Secord, 2006); yet, his work with complex interactions of organisms and habitats inspired the word's creation, and established ecology as a discipline (Acot, 1997; Levin, 2010). Although Darwin is considered to be the *father of ecology,* it was Ernst Haeckel who first defined the term in 1866 stating, "Ecology is the study of the relationship of organisms with their environment" (Bramwell, 1989, p.40).

Between Aristotle and Darwin, natural science and the field of ecology remained relatively static. For over two centuries little was understood of the dynamics between the world of organisms and interactions with their communities (McIntosh, 1985). It wasn't

until natural history and geology eventually merged to become ecology, that a new discipline was accompanied by facts and observations (Levin, 2010).

The 20th century saw ecology transition from a descriptive approach to a more analytical, investigative form of scientific investigation (Kingsland, 2004; McIntosh, 1985). Ecosystem Ecologist Eugene Odum (1913-2002) is credited with clarifying the relationship between specific organisms and their environments with what he called *ecosystems* (EETAP, 2002). Using his observations from quantitative studies, Odum incorporated the investigative approach with modern technology to refine the definition of ecology (Smith & Mark, 2009), allowing it to spread quickly as a scientific discipline (Acot, 1997). In 1957, concerns with environmental literacy curricula prompted Odum and his brother Howard to publish, *Fundamentals of Ecology*, a holistic approach to ecosystem science, and the only textbook in the field for about ten years (Odum, 1992).

Strong scientific ties between ecology and environmental management allowed ecology to gain momentum during the 1960-1970s environmental movement (McIntosh, 1985). Other ecologists such as Aldo Leopold and Rachel Carson voiced their concerns along with the nation's first proposal supporting environmental protection. In 1969 at the United Nations Educational, Scientific and Cultural Organization (UNESCO) Conference in San Francisco, the first Earth Day (1993) was recognized and held on April 22, 1970, and went to the international level in 1990. As the second millennium came to an end, it also brought about changes in the way we view ecology (EETAP, 2002).

Advances in the field of ecology have allowed our thinking to evolve. Where humans were once seen as intruders on the natural world, they are now considered part of the natural world (Botkin 1990; Blondel & Vigne, 1993). The discipline of ecology now

needs to focus on a more responsible role in educating individuals to exist in a *more sustainable* natural world (Palmer et al., 2004). Simmons (2005) states, "if we educate our citizens so they are capable of making quality decision, they will do so when the time comes" (p. 68)

**Ecological Knowledge**

Ecological knowledge is one of the five types of knowledge that must be drawn on to effectively respond to environmental issues (Hollweg et al., 2011). According to Volk and McBeth (1997), the term, ecological knowledge, "refers to the knowledge of major ecological concepts. It also refers to a knowledge and understanding of how natural systems work, as well as a knowledge of how natural systems interface with social systems" (p.74). Volk (2005) found that ecological knowledge is critical for sound decision making and a necessary component when making decisions concerning the environment. She also stressed the need to include ecological knowledge within the environmental education framework to ensure comprehensive content knowledge. Multiple models establish ecological knowledge as both necessary and vital to our future in promoting the development of environmental literacy (Bamberg & Moser, 2007; Hines et al., 1986, 1987). In addition, writers of the *MSELS* instrument contend that ecological literacy is necessary to approach issue resolution in an informed and responsible manner.

The Tbilisi Declaration specifically addresses ecological knowledge in two of its environmental goals and a category of environmental education objectives. The first goal stresses social, political and ecological interdependence; while the second goal is to provide opportunities to acquire the knowledge needed to improve the environment. In the category, *knowledge*, the objective is "to help social groups and individuals gain a

variety of experiences in, and acquire a basic understanding of the environment and its associated problems" (Hollweg, et al., 2011, p. 11; UNESCO-UNEP, 1978).

Palmer et al. (2004) claim, ecological understanding is acquired from various avenues that include, but not limited to, "experimentation, theory and modeling, comparative observations, long-term study, and synthesis" (p. 20). With attention focused on the future, Palmer stressed that fostering intellectual support will require a "new body of knowledge, radically new research agendas, and new ways of ensuring that ecology is a component of the important decisions facing society in the future" (p. 20).

UNESCO (1971) launched the *Man and Biosphere* research program in 1971 with the purpose of increasing the knowledge of the interdependent relationships between man and nature (Kingsland, 2005). Since then, the focus of environmental education has been on educators developing individuals who have responsible knowledge, attitudes and behavior toward the environment (Stapp et al., 1969; Tidball & Krasny, 2011). These foundations are essential in a learning system designed to help individuals understand interactions with one another and with their biophysical elements (Bouillion & Gomez, 2001; Hogan, 2002).

## Research in Environmental Education

**Environmental education defined**. Before the current term was used, the environmental education movement was active under various antecedents as nature study, conservation education, and outdoor education (Disinger, 2005). Since the onset of the environmental movement, a definition of the term *environmental education* has been a major topic for discussion (Disinger, 2005). Numerous definitions exist for the word "environment" (Merriam-Webster, n.d.) and even more are found for the term

"environmental education." A review of relevant literature reveals a lack of consensus on a single definition. The most prevalent issue in establishing a universal definition appears to be the semantics or meaning of the term.

Many scholars (e.g., Disinger & Roth, 1992; Roth, 1992; Payne, 2005, 2006) argue that the various terms for environmental education have been used interchangeably in so many different ways, and are all so encompassing in regards to content, that very little useful meaning can be made from them. Despite the widespread use and conflicting opinions of the term, efforts have been made to identify commonalities across different fields (e.g., science, art, geography, social studies, and citizenship education) and provide a platform that incorporates all strands (McBride, 2011). The question is whether environmental education can be defined as a single subject while still focusing on the varied meanings for people that understand the term from different schools of thought (Disinger, 2005).

When looking at the history and progress of the environmental education movement, it appears that the ultimate goal is to understand the relationship between the biotic and abiotic environment while investing in the role humanity plays catalyzing the changes of the natural world (Disinger, 1985). However, it is the concepts from philosophers and educators in recent decades that has given shape to and provided a firm foundation and consensus on several points that should be included in a working definition for environmental education (Heimlich, 1993). These points include:

- Environmental education is a continuous learning process that evolves according to our experiences as we go through life;

- The ultimate goal, to be achieved through experiential learning, is a change in human behavior; and
- Our educational efforts need to focus on adding a sustainable and environmentally-friendly quality to life.

One of the earliest and most concise definitions—one that served as a template for many subsequent attempts—came in 1969 from a graduate seminar under the leadership of Professor William B. Stapp in the Department of Resource Conservation and Planning of the University of Michigan's School of Natural Resources (SNRE). He called an approach to reach all citizens "environmental education" and defined it in the following way:

Environmental education is aimed at producing a citizenry that is *knowledgeable* concerning the environment and its associated problems, *aware* of how to help solve these problems, and *motivated* to work toward their solution (Stapp, et al., 1969 p. 30).

To help explain the definition, Stapp et al. (1969) also maintained that the objective of environmental education should aid individuals in understanding: 1) that man is part of a system, inseparable from nature with the ability to alter the interrelationships of those systems; 2) the biophysical environment and its role in contemporary society; and 3) the fundamental problems facing man, how to confront them, solve them, and assume the responsibility in finding solutions.

**Environmental education: Historical origin**. Although President Richard Nixon didn't sign the first environmental education act into law until 1970, it was recognized as a distinct field in the mid-1960s (Disinger, 2005). With primary antecedents in nature study, conservation education, and outdoor education, environmental education evolved

as a major component of the environmental movement, creating awareness among the public with vibrant activities that focused on the health and well-being of the planet (Harblin & Maynard, 1976). Historical influences of nature study, conservation education, and outdoor education were concerned with more than just learning about the outdoors. Many of the early environmentalists were concerned with the effect of environmental quality on human health and welfare. They believed the study of the environment should include an understanding of how people could improve nature and help the environment (Nash, 1976).

Beginning in the 1800s, the nature study movement combined scientific investigation with the discovery of nature. The works of progressive educators and naturalists—Emerson's *Nature* (1836), Thoreau's *Walden* (1854), George Perkins Marsh's *Man and Nature* (1864), and Wilbur Jackman's *Nature Study for the Common Schools* (1891) influenced the way science was taught in schools. The movement's mantra "study nature, not books" integrated knowledge by taking students outdoors to learn. Nature study emphasized active involvement in learning the academia by exploring tangible objects through an indivisible environment (Disinger, 2005)

The discourse of nature and human interaction continued in the writings and public speaking in the late nineteenth and early twentieth centuries with renowned writers such as Louis Agassiz (1807-1873), John Muir (1838–1914), Liberty Hyde Bailey (1858-1954), Enos Mills (1870–1922), Robert Marshall (1901–1939), and Aldo Leopold (1887–1948) (McCormick, 1989). Much of what was written, discussed and actually accomplished by these individuals and others during this period centered on resource

conservation and habitat preservation. Furthermore, conservationists specifically focused on the wise and efficient use of natural resources (Gottlieb 1995; Stegner, 1990).

The conservation movement developed as a result of the Great Depression and the Dust Bowl period during the early 1900s. *Conservation education* brought awareness to the misuse of natural resources and focused on rigorous scientific training and resource conservation methods (Cronon, 2013; Palmer, 1998). Consequently, visions of pristine natural environments gained recognition from concerned preservationists through such figures as John Muir of the Sierra Club and Aldo Leopold of the Wilderness Society (Geary, 2003).

In the late 1960s and early 1970s, outdoor educators and conservation activists gained significant momentum as Rachel Carson's (1962) *Silent Spring* made a controversial statement related to humanity's impact on the natural world (Haskin, 1999). Then, in 1963, a report from the President's Science Advisory Board drew national attention to the side effects of the chemical pesticide called DDT (EPA, 2011). The public awakening to pollution and general environmental problems set the stage for the very first "Earth Day" celebration in 1970 and prompted one of environmental education's first endorsements for the conservation of the world's natural resources (Earth Day Network, 1993). Within this atmosphere of growing awareness and concern, the U.S. Environmental Protection Agency (EPA) was created in 1970. Since its inception, the EPA has been responsible for posting an average of 1500 rulemaking notices in the Federal Register annually, all aimed at protecting the environment (EPA, 2011).

**Goals and objectives of environmental education.** Environmental education is a complex process and a dynamic approach to building an environmentally literate

society as a whole. As previously mentioned, the major objectives of environmental education were originally established under the Tbilisi Declaration in 1977, which serve as guidelines for curriculum development (UNESCO-UNEP, 1978). Built upon a framework of goals, objectives and guiding principles, environmental education is a learning process which stresses a hierarchical approach to environmental literacy. It emphasizes the need for all citizens to look outward in an effort to build partnerships that increase awareness about the environment and associated challenges, to develop skills and experiences necessary to address the challenges, and to foster attitudes and problem solving skills needed to effectively work together in achieving a healthy sustainable environment for the present and future generations (UNESCO, 1977).

Environmental education must prepare individuals to be responsive to and understand a rapidly changing technological world (Ramsey, Hungerford, & Volk, 1992), and provide the necessary skills needed to bring about and achieve a dynamic equilibrium between the quality of life and the quality of the environment (Hungerford & Peyton, 1977). When properly understood and implemented, it establishes comprehensive lifelong education that is responsive to changes in a rapidly changing world (UNESCO, 1977).

Together, the Belgrade Charter and the Tbilisi Declaration serve as the foundation for a second education framework which was developed by the NAAEE and included a guidebook which enabled environmental educators to evaluate environmental education materials (Simmons, 2000). This guidebook identified six key characteristics of quality environmental education materials, as well as indicators of what to look for in those materials. The key characteristics include: fairness and accuracy, depth, emphasis on

skills building, action orientation, instructional soundness, and usability. Ultimately, according to the NAAEE, environmental education is about developing new behaviors, not just at the individual level, but, equally important, at the societal level as well. Central to this is developing a common understanding of environmental problems as critical social dilemmas linked to social values, and economic and political processes. At the core of environmental education, therefore, is the belief that examining the underlying values and real causes behind environmental problems is vitally important in determining a course of action to solve them (NAAEE, 2008).

While consensus on a fundamental set of goals for environmental education continues to be of major concern, leaders in the field believe that a solid knowledge foundation is the key to environmental literacy. Yet some environmental educators believe the development of environmental literacy has to extend beyond a knowledge base. For example, Sia (1984) believes that individuals must also be skilled in *citizen action skills,* and that the more knowledgeable individual are in this regard, the more likely they are to behave in an environmentally responsible manner. Similarly, research suggests that environmental program decisions should be based not only on knowledge of issues and their contexts, but also on environmental attitudes, emotions and beliefs (Pooley, 2000).

**The Belgrade Charter of 1975**

For many educators, environmental education gained national recognition and established solid ground in education following the publication of two founding documents (Disinger, 2001): The Belgrade Charter (United Nations Educational, Scientific And Cultural Organization-United Nations Environment Programme

([UNESCO-UNEP], 1976) and the Tbilisi Declaration (UNESCO-UNEP, 1978). Documents submitted to Congress by NEEAC cite the Belgrade Charter of 1975 as the proposed framework and overall goal of environmental education. This environmental education framework is best understood by studying the goals and objectives proposed by the delegations from which it was established.

The Belgrade Charter of 1975 emerged simultaneously with UNESCO's naming of global environmental education as a high priority. As the first documents to recognize education as an important conservation strategy, it was subsequently adopted by the United Nations conference as a framework for environmental education. According to the Belgrade Charter,

> 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, 1975, p. 1)

The conference also identified two distinct, somewhat overlapping categories of environmental education. One was an immediate need, or short term goal, which focused on local decision-makers, community, government, educational and industrial leaders, and the general public to meet the goals set forth by environmental protection legislation, and other issues such as energy. The second, more long-term goal centered on bringing about changes in behavior through formal education. In both the short and long term goals, environmental education was seen as the vehicle to understanding the interactions

of the natural and man-made worlds (Aldrich & Blackburn, 1976). Soon afterwards, the Tbilisi Declaration was adopted.

**The Tbilisi Declaration of 1977**

Two years after the Belgrade Charter, UNESCO, in cooperation with UNEP, held the world's first intergovernmental conference on environmental education in Tbilisi, Georgia (USSR). Built upon the Belgrade Charter, the Tbilisi Report adopted two of the previous conference recommendations for environmental education: (a) to develop new strategies to build a better understanding and awareness of the nations' use and accelerated changes in the balance of nature; and (b) to develop the framework, principles, and guidelines for environmental education at all levels—national, regional, local and international—and for all ages both inside and outside the formal school system (UNESCO, 1977). Environmental education goals that were endorsed are as follows:

- To foster clear awareness of, and concern about economic, social, political and ecological interdependence in urban and rural areas;
- To provide every person with opportunities to acquire the knowledge, values, and 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.

According to UNESCO (1978), the report also identified five categories of instructional objectives for individuals and groups that should be acquired through environmental education.

**Awareness** – to develop an awareness and sensitivity to the environment;

**Knowledge –** to gain knowledge of the environment and its problems;

**Attitudes –** to help individuals acquire a set of values and feelings of concern for the environment and the motivation to be actively involved in environmental improvement and protection;

**Skills –** to identify and solve environmental problems; and

**Participation** – to be actively involved in environmental problem solving.

The overall aim of environmental education is to involve citizens from all sectors of society and to approach them through both formal and non-formal education programs. The challenge for educators is to provide meaningful educational learning experiences that help raise awareness in order to foster environmental ethics that will have long lasting impacts (NAAEP, 1997b).

## Research in Environmental Literacy

**Environmental literacy defined.** Emphasizing affective traits and environmental issues resolution (Hollweg, et al., 2011; Hungerford et al., 1994), environmental literacy has been defined in various contexts in recent years as it has come into widespread use. When searching for a definition of environmental literacy, numerous scholars have argued that the term environmental literacy is synonymous with other terms, such as ecology, ecological literacy, and ecoliteracy, and has been used so broadly and/or interchangeably that the differences are essentially meaningless (Disinger, 1992; Roth, 1992; Stables & Bishop, 2001). Most researchers, however, define environmental literacy as "the capacity to perceive and interpret the relative health of ecosystems and take appropriate action to maintain, restore, or improve the health of these systems" (Disinger & Roth, 1992, p. 1). Hence, most all educational frameworks include knowledge of basic ecological concepts, environmental sensitivity or

appreciation, awareness of environmental issues and problems, and skills and behaviors to prevent and/or resolve those issues as key attributes of the environmentally literate individual. In addition, environmental problem-solving is a common component running throughout these frameworks, which supports ideas put forward by the environmental education movement.

The necessity of environmental literacy was described in President Nixon's Environmental Message to Congress in 1970:

> 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 educational process. (p. 11)

A number of other concepts have been published since 1970. For example, in 1993, the North American Association for Environmental Education (NAAEE, 1997), which promotes environmental education and supports the work of educators, began a multiyear project called the National Project for Excellence in Environmental Education. The initiative addressed environmental literacy and identified examples of high-quality environmental education practices.

Various leading educators have also defined environmental literacy as a multidimensional guideline (Hoody, 1995). The Environmental Literacy Council (Elder, 2008) defined environmental literacy as a fundamental understanding of the systems of the natural world, the relationships and interactions between the living and non-living environment, and the ability to deal sensibly with problems that involve scientific evidence, uncertainty, and economic, aesthetic and ethical considerations. Outlined by

the Environmental Literacy Framework, and developed by the Environmental Literacy Assessment Consortium (ELAC), environmental literacy has: cognitive dimensions (knowledge and skills); affective dimensions; and, additional determinants of environmentally responsible behavior and personal and/or group involvement in environmentally responsible behaviors. The various definitions of environmental literacy call for well-developed skills in perception, interpretation and environmentally-based actions (Hoody, 1995).

Robottom and Hart (1995) claimed environmental literacy is dependent upon well-developed skills in perception, interpretation and personal conduct. Roth (1992) claimed there are three different levels that can be defined as environmental literacy—nominal, functional, and operational. Nominal environmental literacy describes one's ability to recognize basic environmental terms and their definitions, whereas functional environmental literacy is when the individual has a broader understanding of nature and the interactions of human social systems and other natural systems. Finally, operational environmental literacy indicates progress beyond functional literacy in breadth and depth of understanding.

Disinger and Roth (1992) argued that environmental literacy is built on an ecological paradigm. Put into perspective, the environmental literacy framework derives its focus from four basic strands that take it well beyond the typical boundaries of any of the traditional disciplines. These include: (a) the interrelationships between natural and social systems, (b) the unity of humankind with nature, (c) technology and the making of choices, and (d) developmental learning throughout the human life cycle. The environmental literacy framework can be assessed in six individual sections which

include: environmental sensitivity, knowledge, skills, attitudes and values, personal investment and responsibility, and active involvement. In Roth's descriptions, environmental sensitivity and attitudes and values are considered under the term *affects*, while personal investment and responsibility and active involvement are included under the term *behavior*. This creates four strands – namely, knowledge, skills, affect, and behavior – to be addressed in education for environmental literacy.

Environmental literacy components. To be environmentally literate, a person must possess citizen action skills. Therefore, it is crucial for environmental educators to focus on environmental literacy as the main goal of environmental education. Recommendations concerning environmental literacy goals, how it might be measured, and assessed across U.S. learners were used to determine what environmental literacy should be (Volk & McBeth, 1997). Although each of the frameworks developed from the NAAEE Guidelines for Excellence Project are based on different assumptions, Simmons (1995) found commonalities between the plans were considerable. Simmons identified the major components of environmental literacy proposed in each model and designed a draft framework which include: 1) affect, 2) ecological knowledge, 3) socio-political knowledge, 4) knowledge of environmental issues, 5) cognitive skills, 6) environmentally responsive behavior (ERB), and 7) additional determinates of ERB used to determine environmental literacy (see Table 1).

Sia (1986/1987) identified the following seven variables that foster environmental literacy: 1) knowledge of issues, 2) beliefs concerning issues, 3) individual values, 4) individual attitude, 5) locus of control, 6) environmental sensitivity, and 7) knowledge and skills of environmental action strategies. Environmental literacy is a multi-step

process that begins with knowledge and results in active citizen participation. Before an individual can *act* on an environmental problem, that individual must *understand* the environmental problem (Hines et al., 1986/1987).

Table 1

*Environmental Literacy Components as Developed by NAAEE*

| Category | Description |
|---|---|
| Affect | • Refers to factors within individuals which allow them to reflect on environmental problems/issues at the intrapersonal level and to act on them if they judge the issue/problem warrants action (e.g. environmental sensitivity, attitudes and moral reasoning). |
| Ecological Knowledge | • Refers to the knowledge of major ecological concepts. Ecological knowledge also refers to a knowledge and understanding of how natural systems work, as well as knowledge and understanding of how natural systems interface with social systems. |
| Socio-political Knowledge | • Includes an understanding of the relationship between beliefs, political systems, and environmental values of various cultures. Socio-political knowledge also includes an understanding of how human cultural activities (e.g. religious, economic, political, social and other) influence the environment from an ecological perspective. Also included within this category is knowledge related to citizen participation issue resolution. |
| Knowledge of Environmental Issues | • Includes an understanding of environmental problems and issues caused as the result of human interaction with the environment. Also included within this category is knowledge related to alternative solution to issues. |
| Cognitive Skills | • The abilities required to analyze, synthesize and evaluate information about environmental problems/issues and to evaluate a select problem/issue on the basis of evidence and personal values. This category also includes those abilities necessary for selecting appropriate action strategies, and for creating, evaluating and implementing an action plan (e.g. skills pertaining to environmental problems/issues and action/service). |
| Environmentally Responsible Behavior (ERB) | • Includes active and considered participation aimed at solving problems and resolving issues. Categories of environmentally responsible actions are persuasion, consumer action, eco-management, political action and legal action. |
| Additional Determinants of personal ERB | • Includes locus of control/efficacy, and assumption of responsibility |

*Note*. It is noteworthy that at least one review of environmental education research was guided by Simmons' work (i.e., Volk & McBeth, 1997)

Environmental literacy framework. Nationwide assessments for an environmental literacy framework has been defined and developed by many as seen in the numerous definitions and frameworks that have been proposed over the past few decades with similar respect to their components (Coyle, 2005; Disinger, 2005; Harvey, 1977; Hungerford & Volk, 1990; Marcinkowski, 1991; McBeth et al., 2008; Roth, 1992; Simmons, 1995; Stapp et al., 1969; Table 2). As indicated by Roth (1992), environmental literacy is a continuum of understandings, skills, attitudes and habits of mind, and the framework is interdisciplinary requiring a variety of questions and skills to reach responsible answers. Roth's framework for shaping environmental literacy is based on the understanding that the environment is our total surroundings, and applicable to formal and non-formal program development. Environment can be considered to have at least three interconnected, interacting components: 1) the bio-geo-physical (non-human) environment; 2) the social environment; and 3) the mind/body (psycho-physiological) inner environment.

In general, the environmental literacy framework has two broad features in common: (a) they reflect at least four of the Tbilisi categories of objectives for environmental education, namely Knowledge, Affect, Skills, and Participation (Behavior); and (b) they address at least three major thematic emphases associated with environmental education within the United States (Stapp et al, 1974; Swan, 1975), namely, the natural world, environmental problems and issues, and sustainable solutions to these problems and issues. Environmental literacy models built on the NAAEE framework are listed in Table 2.

Table 2
*Frameworks of Environmental Literacy*

| Year | Author | Description of Framework |
|---|---|---|
| 1974 | Stapp & Cox | The spaceship earth philosophy of EL, divided into knowledge of five basic concepts 1) ecosystems, 2) populations, 3) economics and technology, 4) environmental decisions, and 5) environmental ethics. In addition, a set of three processes for EL: 1) problem solving skills essential to developing and carrying out action plans; 2) values clarification to help individuals become aware of their personal beliefs, attitudes, values, and behaviors; and 3) community problem solving-application of both problem solving and valuing to an environmental issue that affects an individual directly. |
| 1977 | *Tbilisi Declaration* UNESCO | Five categories of objectives: 1) awareness- to the environment and its associated challenges; 2) knowledge-basic understanding of the environment and its associated challenges; 3) attitudes-values and feelings of concern for the environment and motivation to actively participate in environmental quality; 4) skills-for identifying and solving environmental problems; and 5) participation at all levels in working toward the resolution of environmental challenges. |
| 1980 | Hungerford et al. | Four goal levels of EL: Level 1) ecological foundations-understanding of major ecological concepts in areas such as species' interaction and interdependence, energy flow and material cycling, and succession and abilities to apply that knowledge to the analysis of environmental issues, the selection of appropriate sources of scientific information in order to find solutions for environmental problems, and the prediction of ecological consequences of alternative solutions to environmental problems; Level II) conceptual awareness-understanding how humans perceive and value he environment and how their behavior effects it, and an ability to identify the cultural implications of a wide variety of environmental issues and their alternative solutions; Level III) investigation and evaluation-abilities to identify and investigate environmental issues using both primary and secondary sources of information, and evaluate alternative solutions to those issues; and Level IV) issue resolution-competence with a variety of environmental action skills, such as persuasion, political action, legal action and eco-management. |
| 1990 | Ballard & Pandya | Knowledge of three key systems-1) general (environment, earth, biosphere) abiotic components, biotic components, processes, biological systems; 2) resource systems-natural sources distribution, consumption, management, and conservation, abiotic resources, biotic resources, degradation of resource base; 3) human systems-humans and environment, technological systems, social systems, environmental awareness and protection. |

Table 2 (continued)

| Year | Author | Description of Framework |
|---|---|---|
| 1990 | Iozzi & Marcinkowski | Five taxonomies of educational objectives for EL: 1) cognitive domain- knowledge of basic ecological concepts and an understanding of environmental problems and issues, and skills for selecting, creating, evaluating, and/or implementing action strategies and plans; 2) affective domain- environmental sensitivity, responsible attitudes toward environmental issues, values, moral reasoning, and ethics; 3) responsible environmental behavior active participation aimed at solving problems and resolving issues; 4)locus of control ; and 5) assumption of environmental responsible behavior. |
| 1991 | Curriculum Task Group, ASTM | Twelve recommendations for EL: 1) impart overall environmental awareness and knowledge; 2) recognize and emphasize ecology as a critical cornerstone; 3) communication and application of major ecological concepts; 4) communication and application of major social science concepts; 5) understanding of human dependence upon stable and productive ecological and social systems; 6) identify a wide variety of environmental issues and problems and application of ecological and social science concepts in interpreting these issues and problems; 7) describe how human behavior, beliefs, values and cultural activities impact the environment; 8) recommend various issue identification strategies using both primary and secondary sources of information; 9) identify various alternative solutions to environmental problems and prediction of possible or probable consequences of solutions to these problems; 10) demonstrate strategy for the identification, evaluation and modification of personal and group value, positions and action strategies, relative to the environment; 11) demonstrate strategies for the correction of environmental problems; and 12) identify sources of scientific and social scientific information appropriate to the investigation and evaluation of environmental issues, problems and solutions. |
| 1991 | Marcinkowski | Nine items comprising EL: 1) awareness and sensitivity toward the environment; 2) attitude of respect for the natural environment, and of concern for the nature of magnitude of human impact on it; 3) knowledge and understanding on natural systems, and how social systems interface with natural systems; 4) understanding of the various environmentally-related problems and issues across multiple scales local to global; 5) skills required to analyze, synthesize and evaluate information about environmental issues using primary and secondary sources and evaluate a select problem on the basis of evidence and personal values; 6) sense of personal investment responsibility and motivation to work individually and collectively toward resolution of environmental challenges; 7) knowledge of strategies available for use in remediating environmental challenges; 8) skills required to develop, implement and evaluate single strategies, and composite plans for remediating environmental challenges; and 9) active involvement at all levels in working toward the resolution of environmental challenges. |

Table 2 (continued)

| Year | Author | Description of Framework |
|---|---|---|
| 1992 | Roth | Three levels of EL- 1) nominal- an environmentally literate person capable of recognizing and providing working definitions of the basic terms used in communicating about the environment, and has awareness, sensitivity, and attitude of respect and concern for natural systems; 2) functional-an environmentally literate person with a broader understanding of the interactions between natural systems and human social systems and is aware and concerned about negative interactions between those systems. Individual has developed the skills to analyze, synthesize, and evaluate information about environmental issues, and evidences a personal investment and motivation to work toward remediation; 3) An operationally environmentally literate person has expanded in breadth and depth with understandings and skills. The individual demonstrates a strong, ongoing sense of investment in responsibility for preventing or remediating environmental degradation, and advocates action to sustain a healthy environment. |
| 1995 | Simmons | Seven elements of EL-1) Affect (e.g. environmental sensitivity, attitudes, and moral reasoning; 2) ecological knowledge; 3) Socio-political knowledge (cultural, political, economic and other social factors to ecology and the environment; 4) Knowledge of environmental issues; 5) Skills pertaining to environmental issues-action strategies, systemic thinking, and forecasting; 6) Determinants of environmentally responsible behavior (locus of control and assumption of personal responsibility); 7) Behavior (i.e., various forms of active participation aimed at solving and resolving problem issues). |
| 1997 | Wisconsin Center for Environmental Education | Four EL outcomes: 1) cognitive-knowledge of ecological foundations (individuals, populations, and communities, change and limiting factors, energy flow, biochemical cycling, ecosystems and biodiversity); knowledge of environmental problems; and knowledge of environmental issue investigation and action strategies; 2)affective-environmental sensitivity and values related to the prevention and remediation of environmental issues; 3) determinants of ERBs-locus of control, assumption of personal responsibility; and 4) ERBs eco-management, economic action, persuasion, political action, and legal action. |

Table 2 (continued)

| Year | Author | Description of Framework |
|---|---|---|
| 1999 | NAAEE | Four strands of EL: 1) questioning analysis, and interpretation skills-familiarity with inquiry, mastery of fundamental skills for gathering and organizing information, interpreting and synthesizing information to communicate explanations; 2) knowledge of environmental processes and systems-the Earth as a physical system, the living environment, humans and their societies, environment and society; 3) skills for understanding and addressing environmental issues-skills for analyzing and investigating environmental issues, decision-making and citizenship skills; 4) personal and civic responsibility-willingness and ability to act on one's own conclusions about what should be done to ensure environmental quality. |
| 2000 | EPA/EETAP | Seven variables that foster EL:1) knowledge of issues, 2) beliefs concerning issues; 3) individual values; 4) individual attitude; 5) locus of control; 6) environmental sensitivity; and 7) knowledge and skill of environmental action strategies |
| 2005 | Coyle | Three levels of EL: 1) environmental awareness-simple familiarity with an environmental subject with little real understanding of it deeper causes and implications; 2) personal conduct knowledge-willingness to go a step further to take personal action and make connections between an environmental issue and one's individual conduct; and 3) EL involves imparting underlying principles, and the skills needed to investigate it, and understanding how to apply that information. |
| 2008 | McBeth et al. | Four components of EL: 1) foundational ecological knowledge; 2) environmental affect-verbal commitment, environmental sensitivity, environmental feeling; 3) cognitive skills-issue identification, issue analysis, action planning; 4) behavior-actual commitment, such as pro-environmental behavior. |

*Note:* Frameworks are listed in chronological order in author's terminology. Table abbreviations: UNESCO (United Nations Educational Scientific and Cultural Organization); ASTM (American Society for Testing and Materials), EL (environmental literacy), NAAEE (North American Association for Environmental Education); EPA/ EETAP (Environmental Protection Agency/Environmental Education Training and Partnership); ERBs (environmentally responsible behaviors)

All the frameworks identifying an environmentally literate citizen have specific key components that include: (a) knowledge of basic ecological concepts; (b) environmental sensitivity or appreciation; (c) awareness of environmental issues and problems; and (d) skills and behaviors to prevent and/or resolve those issues as key. Environmental problem-solving is a concept throughout these frameworks, suggesting a strong overarching goal of the environmental education movement (McBride, 2011). In addition, each framework identifies environmentally literate citizens as concerned with environmental issues and problems and possess the attitudes and skills for solving them. Some frameworks recommend desirable attitudes and values, while others focus on the construction of individual values systems as demonstrated in Table 3. Hence, issue resolution requires environmentally literate individuals to address their own behavior, to identify ecological consequences related to issues and to promote solutions in a comprehensive manner (Volk, 2005).

Table 3

*Elements of Environmental Literacy in Literature*

| Environmental Education Agency/Researcher | Environmental Literacy Elements | | | | | | |
|---|---|---|---|---|---|---|---|
| | Affect | Ecological Knowledge | Socio-Political Knowledge | Knowledge of Environmental Issues | Skills | Environmentally Responsible Behaviors (ERSs) | Additional Determinants of ERBs |
| Stapp & Cox (1974) | X | X | X | X | X | X | |
| Tbilisi (1978) | X | X | X | X | X | X | X |
| Hungerford et al (1980) | X | X | X | X | X | X | |
| Ballard & Pandya (1990) | X | X | X | | | X | |
| Iozzi et al. (1990) | X | X | | X | X | X | X |
| Curriculum Task Group ASTM (1990) | X | X | X | X | X | X | |
| Marcinkowski (1991) | X | X | X | X | X | X | X |
| Roth (1992) | X | X | X | X | X | X | X |
| Simmons (1995) | X | X | X | X | X | X | X |
| Wisconsin Center for Environmental Education (1997) | X | X | | X | X | X | X |
| NAAEE (1998) | X | X | X | X | X | X | X |
| EPA/EETAP (2000) | X | X | X | X | X | X | |
| Coyle (2005) | X | X | X | X | | X | |
| McBeth et al. (2008) | X | X | X | X | X | X | X |

*Note*: Table abbreviations: UNESCO (United Nations Educational Scientific and Cultural Organization); ASTM (American Society for Testing and Materials), EL (environmental literacy), NAAEE (North American Association for Environmental Education); EPA/ EETAP (Environmental Protection Agency/Environmental Education Training and Partnership); ERBs (environmentally responsible behaviors)

# Chapter III

## Methodology

This study was conducted with sixth, seventh, and eighth grade African American students in a suburban setting and completed during the school day. The survey administered was quantitative and non-experimental in nature and designed to measure ecological knowledge and verbal commitment to pro-environmental actions. The questionnaire data collection procedure was appropriate for the age group selected and convenient for the students participating.

### Purpose

Ecological knowledge of African American middle school students and their pro-environmental intent was the foundation for this study. Unfortunately, the literature on these subjects remains quite minimal. The lack of empirical information about young African American's knowledge or attitude towards the environment calls for an examination of environmental concerns of students at the middle school level. Volk and McBeth (1997) argue for more focus on ecological knowledge, socio-political knowledge, and additional determinants of environmentally responsible behavior. They recommend "a national literacy assessment, or series of assessments. Such a series of assessments should include individuals representative of a variety of geographic areas and other demographic factors" (p.80).

Since the environmental movement began, adolescents' views have been largely ignored in studies of public opinion (Wray-Lake et al., 2010). Research found only a few studies focused on ecological knowledge, ecological literacy, or attitudes toward the environment in minority groups across the United States, despite the country's changing

demographics (Lee, 2008). According to the U.S. Census Bureau (2010), minorities will become the majority of the U.S. population by the year 2042. Educating the minority population on environmental issues is especially urgent in Texas, where as of 2010 the majority of residents are listed as minorities (Texas State Data Center, 2011).

Educators in many countries have called attention to the need for data on the status of environmental literacy among their citizens. An early example, approved in 1978, was a call for research within all UN Member States on selected components of environmental literacy (i.e., knowledge, attitudes, values, and behavior) (*Intergovernmental Conference on Environmental Education*, UNESCO, 1977, p. 38). Therefore, this study will provide a baseline that can be used to make comparisons over time to future studies and with other ethnic group data. The method of study in this research employs a methodological protocol that has been tested for validity and reliability and follows data analysis procedures suggested by McBeth et al. (2008).

**Sample**

The participants in this study included 287 sixth, seventh, and eighth grade students from a sample of convenience in a suburban setting who attended public school in Houston Texas. The eligible students were given an informed consent document for their parents to sign as well as an assent document indicating their willingness to participate. Consent and Assent Forms can be found in Appendix B.

Participants were all African-American between 11 and 15 years in age. Of the 313 sixth grade students that were asked to participate, 125 (39%) returned parental consent forms, indicated they were willing to participant. These 125 sixth graders , were present on the day the survey was administered and all fully completed the survey. Of

the 269 seventh grade students that were asked to participate, 100 (36%) returned parental consent forms, indicated they were willing to participant, were present on the day the survey was administered and fully completed the survey. Of the 247 eighth grade students that were asked to participate, 62 (24%) returned parental consent forms, indicated they were willing to participant, were present on the day the survey was administered and fully completed the survey.

The students participating in this study spent an average of one and one half hours in each of their three classes (math, science and English Language Arts) during regular school hours. The science teachers from each grade level administered and collected the surveys during science class. The students that did not participate in the survey were either not African American or did not obtain parental consent to participate.

Sheldon Independent School District (ISD) is a public school district in unincorporated northeast Harris County, Texas. Sheldon ISD serves several subdivisions and communities that lie in Houston's extraterritorial jurisdiction. The district serves about 7,500 students and as of 2013, the school district is rated as having "Met Standard" under the new Texas Education Agency accountability ratings (TEA, 2013).

**Survey Instrument**

The instrument used for this study was the Middle School Environmental Literacy Survey *or MSELS* which was developed by Hungerford, Volk, Bluhm, McBeth, Meyers, and Marcinkowski (2005) for students in grades six to eight. The *MSELS* is one of the products of the Environmental Literacy Assessment Consortium (ELAC), a group of researchers from the University of Wisconsin-Stevens Point, Southern Illinois University at Carbondale, Florida Institute of Technology in Melbourne, and the University of

Tennessee-Knoxville. It reflects environmental literacy as defined by experts (Hungerford, Peyton, & Wilke, 1980; McBeth et al., 2008; Roth, 1992; Simons, 2005), and used by the developers in a nation-wide environmental education project. Permission to use the instrument was granted by the developers for this study (see Appendix C). Contact information and how to obtain a copy of the instrument can be found in Appendix A.

The *MSELS* was selected for this research project because it reflects the fundamental principles set forth by UNESCO (1978). It also identifies the goals and objectives developed by The Tbilisi Conference. The four survey domains: Knowledge, Affect, Cognitive skills and Behavior serve as stepping stones to prepare and enable citizens, including students, in creating a sustainable future with active involvement in the prevention and resolution of environmental issues (McBeth et al., 2008).

The *MSELS* is a 68 item survey that measures environmental literacy with multiple choice and Likert-type items and was designed to be administered within a traditional 50-minute class period. The survey measures the following environmental literacy components: (a) ecological knowledge; (b) verbal commitment; (c) actual commitment, or environmental behavior; (d) environmental sensitivity; (e) issue identification and issue analysis skills; and (f) action planning. Due to time constraints, and decisions out of my control, only Parts I, II, and III of the *MSELS* was administered for this research project, a total of 33 multiple choice questions, and Likert-type items (Table 4).

**Description of the MSELS**

**Part I**: **About Yourself**. This section of the survey includes four items used to collect demographics on participants: age, grade, gender, and ethnicity.

**Part II**: **Ecological Foundations**. This section delineates content knowledge necessary for individuals when making ecologically sound decisions. The individual should be able to communicate and apply ecological concepts that focus on individual and species populations; communities; ecosystems; homeostasis; environmental influences such as carrying capacity and limiting factors; interaction and interdependence; succession; energy flow; nutrient and materials cycling; humans as members of ecosystems; and ecosystem concepts (Marcinkowski, Volk, & Hungerford, 1990). Included in this section are seventeen multiple-choice items designed to test cognitive ecological aspects of the participants. Each item is worth one point making the scores range from 0-17. A high score in this section indicates that the participant has ecological content knowledge.

**Part III. How You Think About the Environment.** This section of the *MSELS* contains self- report items that judge the willingness or intent of the student to engage in pro-environmental activities. The responses are listed on a 5-point Likert scale from *Very True* to *Very False*. Nine of the 12 statements are worded in the affirmative (I would be willing…), and three of the statements are worded in the negative (I would not be willing…). When scoring this section, different values are assigned to each response. The affirmative statements, *very true* received five points, *mostly true* received four points, *not sure* received three points, *mostly false* received two points, and *very false* receive one point. The negative statements are reversed where *very false* received five

points and *very true* received one point. The student receives a total score for the section by totaling the twelve items, where 12 is the lowest possible score and 60 is the maximum highest score. The higher the score, the more willing the student is to engage in pro-environment activities. This section does not depict what the students will actually do, but rather what they verbally commit to be willing to do. See Table 4 below for an overview of MSELS.

Table 4

*Overview of Middle School Environmental Literacy Survey (MSELS)*

| Domain Name | Specific Variable | Section of *MSELS* | Item No. | N Items | Possible Points |
|---|---|---|---|---|---|
| Ecological Foundations | Ecological Knowledge | Part II | 5-21 | 17 | 17 |
| How You Think About the Environment | Verbal Commitment | Part III | 22-33 | 12 | 60 |

**Validity and Reliability**

Construct validity was established for the *MSELS* by the writers of the instrument through an 18-member panel. Validity was determined by 16 members of the panel of experts and exploratory and confirmatory factor analysis. The 16 panel members who returned validity assessments represented various fields of education and government offices: four were middle school teachers; two were high school life/environmental science teachers; two were school district environmental education coordinators; six were university environmental educators/researchers; and two were officers in state/federal agencies related to environmental education (McBeth, et al., 2008; NEEAC, 1996; Simmons, 1995; Stapp et al., 1969; & UNESCO, 1977).

Reliability of *MSELS* scales were also undertaken by the writers of the instrument. Data were analyzed from the national baseline study (McBeth et al., 2008) that included scores from students in two locations, Steeleville, Illinois and Molokai, Hawaii. Students were placed in three groups based on their *MSELS* scores, high, middle and low. The middle scores were eliminated. The high and low group scores were compared using T-tests and Cronbach's Alpha Coefficient. T-tests found significant differences between four of the seven subsets and total survey scores. Internal consistency of the instrument was reported with acceptable reliability estimates using Cronbach's Alpha Coefficient (McBeth, et al., 2008).

**Data Collection**

Data were collected from students that returned a letter of informed consent from parent or legal guardian (See Appendix B). Students that participated in the study were given an Assent Form indicating their willingness to participate. Both parental consent forms and assent forms have been retained by the researcher.

The *MSELS*S was administered in May 2014 to ensure that all students received instruction in all four disciplines of science: nature of science; physical science; earth science; and life science. The survey was administered during one science class period to participants. Students read and recorded their answers without teacher or researcher intervention. They were only given help if they raised their hand asking for clarification on a question. The survey took approximately 20 minutes to complete.

**Scoring the Surveys**

The researcher scored each survey by hand. Data were entered into SPSS 22.0 (Statistical Package for the Social Sciences), calculated, and analyzed. These results were

then used to analyze the *ecological knowledge and verbal commitment* of sixth seventh and eighth grade African American students.

**Data Analysis**

*MSELS* is quantitative and non-experimental in nature. After the surveys were hand scored, the survey responses were entered into a statistical analyses program using IBM SPSS Statistics 22.0 (SPSS Inc., Chicago, IL). Descriptive statistics (mean, standard deviation, and range of scores) were calculated for *Ecological Knowledge* and *How You Think About the Environment* for the sixth, seventh, and eighth grade sample. These scores were compared to the descriptive statistics from a similar national sixth, seventh and eighth grade study provided by McBeth et al. (2011). In addition, descriptive statistics were calculated for the participants to generate group profiles. The calculated data for sixth, seventh and eighth grades were compared to the national sample provided by McBeth et al. (2011). The purpose of this study was to describe a sample; therefore, descriptive statistics was deemed appropriate (Drew, Hardman, & Hosp, 2008).

It should also be noted, not all the surveys could be used. Some were missing multiple choice answers to the questions; others were missing demographic data. There were 13 missing answers on Part II, *Ecological Knowledge*, and 29 missing answers on Part III, *How You Think About the Environment*. Eight surveys were deleted because of missing demographic information. One seventh grade male participant answered Part II, leaving Part III entirely blank, thereby changing the male population for grade 7 by one. Therefore, Part II *Ecological Knowledge* was analyzed using surveys from100 seventh grade students, while Part III *How You Think About the Environment* was analyzed using surveys from 99 seventh grade students.

**Composite Scores**

McBeth et al. (2008) confirmed the need for these data from educational policy makers, administrators and practitioners for single scores representing environmental literacy. More useful will be the ability to compare scores in each domain for various ethnic groups. The mean scores from the McBeth et al. (2008) study were adjusted and used to calculate composite scores to ease interpretation of and to facilitate use of the results. Each of the four domains (Knowledge, Affect, Skills, and Behavior) were adjusted and equated equally to 60 points as shown in Table 5. For that reason, the highest possible score for each domain is 60, with an overall high score of 240. For the purposes of this study, only Part II, Ecological Knowledge and Part III, *How You Think About the Environment* were used.

McBeth et al. (2008) explained how this scoring technique can easily be divided into thirds and categorized into high, moderate and low levels. Table 5 also lists the ranges and the overall value associated with each level. These ranges are intended to be standard and used for comparative purposes only in subsequent studies using the *MSELS.* (See Table 5 on the following page.)

Table 5

*Ranges of Low, Moderate, and High Levels of Environmental Literacy*

| Domain | Low Level | Moderate Level | High Level |
|---|---|---|---|
| Ecological Knowledge | 0-20 | 21-40 | 41-60 |
| Environmental Affect | 12-27 | 28-44 | 45-60 |
| Cognitive Skills | 0-20 | 21-40 | 41-60 |
| Behavior | 12-27 | 28-44 | 45-60 |
| Overall Score | 24-96 | 97-128 | 19-240 |

*Note*. Adapted from McBeth et al., 2008

The national study calculated composite scores in each for the four domains (*Ecological Foundations, Environmental Affect, Cognitive Skills, and Behavior*) for sixth, seventh, and eighth grades. The entire sampling used multipliers set by the designers of the survey. The scores from each domain were combined to generate a composite Environmental Literacy score. For this paper, *Ecological Knowledge* and *How You Think About the Environment* were measured using the multipliers illustrated in Figure 1 on the following page.

*Figure 1*

Adjusted Raw Scores on *MSELS*

| Domain of Environmental Literacy | Specific Conceptual Variables | MSELS | Item Number | N Items | Range of Possible Scores | Multiplier | Adjusted Score |
|---|---|---|---|---|---|---|---|
| Ecological Knowledge | Ecological Knowledge | Part II: Ecological Foundations | 5-21 | 17 | 0-17 | 3.529 | 60 |
| Environmental Affect | Verbal Commitment (Intention) | Part III: How You Think About the Environment | 22-33 | 12 | 12-60 | 0.5 | 30 |
| | Environment Sensitivity | Part V: You and Environmental Sensitivity | 46-56 | 11 | 11-55 | 0.4615 | 25 |
| | Environmental Feeling | Part VI: How You Feel About the Environment | 57, 58 | 2 | 2-10 | 0.4615 | 5<br>60 |
| Cognitive Skills | Issue Identification | Part VII A: Issue Identification | 59, 60, 67 | 3 | 0-3 | 6.67 | 20 |
| | Issue Analysis | Part VII B: Issue Analysis | 61-66 | 6 | 0-6 | 3.33 | 20 |
| | Action Planning | Part VII C: Action Planning | 68-75 | 1 | 0-20 | 1.00 | 20<br>60 |
| Behavior | Actual Commitment (Pro-environmental Behavior) | Part IV: What You do About the Environment | 34-45 | 12 | 12-60 | 1.0 | 60 |
| | | | Total | 68 | 37-231 | — | 240 |

From: McBeth, B., Hungerford, H. Marcinkowski, T., Volk, T., Meyers, R. (2008). National environmental literacy assessment project: Year 1, national baseline study of middle grades students' final research.

The composite scores generated in this study were compared to the national composite scores for sixth, seventh and eighth grade students provided by McBeth et al. (2011). Scores were calculated against the high, moderate and low ranges of *ecological knowledge and verbal commitment*, and compared to the national calculated averages. *Ecological Knowledge* was the only section completed by the participants in its entirety; and the only section using the adjusted score of 60 points as an indicator of high, moderate and low levels of environmental literacy. Part III, *How You Think About the Environment* (*30 points*) constitutes one-half the variables of the Environmental Affect Domain. Part V, *Environmental Sensitivity (25 points)*, and Part VI, *How You Feel About The Environment* (*5 points*) together make up the second half of this domain and the other 30 points. Data were not collected on Part V or Part VI of the *MSELS*; therefore, Environmental Affect data can only score a maximum of 30 points (see Figure 1on page 57). High, moderate, and low levels of Environmental Literacy were also compared at half the total score for the Environmental Affect domain.

**Impact on Participants**

This research was non-invasive and had little impact on the participants. The survey was completed in approximately 20 minutes and did not require students to disclose sensitive information. The survey was confidential; no grade was assigned; and there were no consequences for non-participation or non-completion. Individual feedback was not provided because names were not associated with the surveys.

**Dissemination of Findings**

Dissemination of findings is a very significant part of this research. Disseminating the process and outcomes of the research and making the findings

available to the broader academic, clinical and general community is important. The final results of this study will provide a base line in which to add literature to an area lacking at this time. It will also provide a sense of understanding on the level of environmental literacy within the African American community and fill a gap presently in place for this population. The findings can be presented at state and national conferences and submitted to social science, education and environmental journals for publication. In addition, the findings can be compared with other literature on the topic of *ecological knowledge and verbal commitment* toward pro-environmental intent. These data are beneficial and serve as a foundation in making recommendations with the framework of environmental education and science instruction.

# **Chapter** IV

## Results

The purpose of this study was to determine *ecological knowledge and verbal commitment* for sixth, seventh, and eighth grade African American students in a suburban environment. The study utilized the Middle School Environmental Literacy Survey (*MSELS),* an instrument proven both valid and reliable for measuring environmental literacy in grades six through eight. Descriptive statistics was used to analyze Part II, *Ecological Foundations (Ecological Knowledge),* and Part III, *How You Think About the Environment (Verbal Commitment)* of the *MSELS.*

This section presents results of the descriptive statistics gathered from the data on *N=287* African American sixth, seventh, and eighth grade students for the ecological knowledge component and compared to *N=7806* sixth, seventh, and eighth grade national data. The verbal commitment component from this study collected data from *N=286* African American sixth, seventh, and eighth grade students and compared to N=7759 sixth, seventh, and eighth grade national data. The national data include research from a combination of ethnic groups and vary in number due to a high percentage of missing responses. Approximately 65% of the national data indicated their ethnic/racial background as White, Non-Hispanic; 10 -15% Black, Non-Hispanic; 7-11% Hispanic; and 5-8% Asian/Pacific Islander. Approximately 2-3% indicated American Indian/Native Alaskan ethnicity, and 1% or less offered multiple responses (McBeth et al, 2011). These demographic statistics are followed by the composite scores for *ecological knowledge and verbal commitment* for pro-environmental behavior components. The mean scores for both components (*ecological knowledge* and *How You Think About the*

*Environment*) and their composite scores are then compared to national means data provided by McBeth et al. (2011).

**Ecological Knowledge**

Part II of the *MSELS, Ecological Foundations,* measured ecological knowledge, a critical component in making decisions concerning the environment. This section contained 17 multiple-choice items; each correct answer earned one point. The range of possible scores in this section was 0-17. Table 6 outlines the descriptive statistics for grades six, seven and eight and the total sample.

Table 6

*Summary of Mean Scores Part II, Ecological Foundations*

| Grade | Sample Size *n* | Mean | Standard Deviation | Range |
|---|---|---|---|---|
| Sixth | 125 | 9.92 | 2.84 | 12 |
| Seventh | 100 | 13.18 | 2.71 | 12 |
| Eighth | 62 | 11.00 | 2.34 | 10 |
| All Grades | 287 | 11.29 | 3.05 | 14 |

*Note.* N = 287. Section = 17 items. Correct responses earn 1 point. Score range is 0-17.

These results indicate that the mean score for seventh grade ecological knowledge, *M* = 13.18 or 77 % scored more than 13 of the 17 questions correct. This is higher than both the sixth (*M* = 9.92 or 58% correctness), and eighth grade (*M* = 11.00 or 65% correctness) results. The mean for all grades was *M* = 11.29 or 66% correctness. The ranges in each grade level—sixth, seventh, and eighth—were borderline high at 12, 12, and 10, respectfully, as the total possible score for this section was 17.

The 17-item measure of ecological knowledge from the national data indicate the

mean score for eighth graders was the highest, *M* = 12.18, followed by seventh grade, *M* = 11.89, and then sixth grade *M* = 11.41. The national mean data indicate the sixth and eighth grade students outscored the students from this sample by 1.49 and 1.18 points respectfully. The seventh grade sample from this research outscored the seventh grade national scores by 1.29 points, a difference of seven percent, indicating the sample seventh grade students in Texas have more ecological knowledge than the national average.

**Verbal Commitment**

Part III of the *MSELS, How You Think About the Environment,* consisted of 12 items designed to measure what the individual would be willing to do or intend to do regarding the environment. Scores in this section ranged from 12-60 with 60 representing high intent and commitment to participate in pro-environmental activity. Results from this section are represented in Table 7.

Table 7

*Summary of Mean Scores Part III, How You Think About the Environment*

| Grade | Sample Size *n* | Mean | Standard Deviation | Range |
|---|---|---|---|---|
| Sixth | 125 | 44.39 | 7.09 | 44 |
| Seventh | 99 | 41.74 | 8.74 | 58 |
| Eighth | 62 | 42.11 | 11.34 | 44 |
| All Grades | 287 | 42.98 | 8.79 | 60 |

*Note.* N = 286. Section = 12 self-report items. Responses earn between 1-5 points. Scores range from 12-60 points.

The results in this section indicate that the mean scores for sixth grade (*M* = 44.39 out of 60) outscored both the seventh (*M* = 41.39 out of 60) and the eighth (*M* = 42.11 out

of 60) graders. The sample from this study shows the seventh graders scoring lower than the sixth (2.65 points) and eighth (2.28 points) graders. The standard deviation for the eighth grade data was over 11, indicating that the scores varied substantially. Slightly more than 70% of the eighth grade scores ranged from 30.77 to 53.45. The sixth grade data show slightly more than 74% of the scores ranged from 37.3 to 51.48, and data from the seventh grade indicate 69% of the scores ranged from 33.00 to 50.58, the lowest scores on this section.

When the 12-item measure of verbal commitment was compared to the national results, the combined overall mean scores from sixth, seventh, and eighth ($M$ = 42.98) grades from this sample scored slightly higher than the eighth grade ($M$ = 42.83) national data. The seventh grade ($M$ = 41.74) mean scores from this sample was more than one point lower than the national (43.34) average. The sixth ($M$ = 44.39) and eighth ($M$ = 42.11) grade samples were both outscored by less than one point from the national mean ($M$ = 45.27), and ($M$ = 42.83) respectfully. Table 8 compares sixth, seventh and eighth grade results from this study and to sixth, seventh and eighth grade results from national data on components ecological knowledge and verbal commitment.

Table 8
*Results and National Norm Data*

| | Grade | N Students | | Ecological Knowledge (0-17) | % of Possible Points | Verbal Commitment (12-60) | % of Possible Points |
|---|---|---|---|---|---|---|---|
| Research Data | 6th | 125 | Mean | 9.92 | 58% | 44.39 | 74% |
| | | | *SD* | 2.84 | | 7.09 | |
| | 7th | *100/99 | Mean | 13.18 | 77% | 41.74 | 69% |
| | | | *SD* | 2.71 | | 8.74 | |
| | 8th | 62 | Mean | 11.00 | 65% | 42.11 | 70% |
| | | | *SD* | 2.34 | | 11.34 | |
| | All Grades | *287/286 | Mean | 11.29 | 66% | 42.98 | 72% |
| | | | *SD* | 3.05 | | 8.79 | |
| National Data | 6th | *3058/3064 | Mean | 11.41 | 67% | 45.27 | 75% |
| | | | *SD* | 3.42 | | 8.67 | |
| | 7th | *2654/2644 | Mean | 11.89 | 70% | 43.34 | 72% |
| | | | *SD* | 3.50 | | 9.32 | |
| | 8th | *2094/2051 | Mean | 12.18 | 72% | 42.83 | 71% |
| | | | *SD* | 3.65 | | 9.14 | |
| | All Grades | *7806/7759 | Mean | — | — | — | — |
| | | | *SD* | — | | — | |

Note. * represents the total number of students in that grade level for each component; Ecological Knowledge (Part II) / Verbal Commitment (Part III).

**Composite Scores by Domain**

Four domains are critical in achieving environmental literacy—Knowledge, Environmental Affect, Cognitive Skills, and Behavior. To describe a more holistic picture of environmental literacy, the writers of the *MSELS* instrument calculated composite scores for each grade level to demonstrate high, moderate and low levels of environmental literacy in each of the four domains (refer to Table 5 on page 56). Composite scores were calculated by adjusting the mean scores using multipliers so that

each component was equated to 60 (see Figure 1 on page 57). *Ecological knowledge and verbal commitment* (intention), which falls under the *Environmental Affect* component of environmental literacy and generated half the total score for this variable, were analyzed with this sample and compared to the national data.

**Domain One: Ecological Knowledge**

Domain one of environmental literacy is Knowledge. Part II of the *MSELS, Ecological Foundations,* measures the ecological knowledge component of environmental literacy. Table 9 represents the composite scores for sixth (35.01 out of 60), seventh (46.51out of 60) and eighth (38.82 out of 60) grade students using the multiplier. From the results, the adjusted score for this sample was higher than the adjusted national average for the seventh grade (44.11out of 60) but lower for sixth (41.68 out of 60) and eighth (43.77 out of 60) grades as reported by McBeth et al.(2011). When compared to the high, moderate and low levels of the domain, the results of this sample indicate the seventh grade was well into the high level of ecological knowledge, but the sixth and eighth grades fell into the upper moderate levels of the domain. When sixth, seventh, and eighth grade scores were combined, the composite score from this sample scored just under a high level of ecological knowledge (39.84 out of 60).

Table 9
*Composite Scores by Grade Level-Domain One, Knowledge*

| Grade | Variable | Mean | Multiplier | Adjusted/ Composite Score |
|---|---|---|---|---|
| Sixth | Knowledge | 9.92 | 3.529 | 35.01 |
| Seventh | Knowledge | 13.18 | 3.529 | 46.51 |
| Eighth | Knowledge | 11.0 | 3.529 | 38.82 |
| Total | Knowledge | 11.29 | 3.529 | 39.84 |

*Note*. N = 287. Part II of *MSELS – Ecological Foundations.* Multiplier for this section is 3.529. The maximum adjusted composite score for Knowledge = 60.

**Domain Two: Environmental Affect**

Domain two of environmental literacy is Environmental Affect Part III of the *MSELS, How You Think About the Environment (Intention)* which measures one-half the variables associated with this domain. Table 10 represents the composite scores for sixth (22.19 out of 30), seventh (20.87 out of 30) and eighth (21.05 out of 30) grade African American students using the multiplier 0.5. Because only half the data for this domain was collected, the composite scores for this section add up to 30.

Table 10

*Composite scores by Grade Level-Domain Two, Environmental Affect*

| Grade | Variable | Mean | Multiplier | Adjusted/ Composite Score |
|---|---|---|---|---|
| Sixth | Verbal Commitment | 44.39 | 0.5 | 22.19 |
| Seventh | Verbal Commitment | 41.74 | 0.5 | 20.87 |
| Eighth | Verbal Commitment | 42.11 | 0.5 | 21.05 |
| Total | Verb Commitment | 42.98 | 0.5 | 21.49 |

*Note.* *N*=286. Part III of *MSELS—How You Think About the Environment (Intention).* Multiplier for this section is 0.5. The maximum adjusted score for Environmental Affect = 30.

The composite score for sixth grade (22.19) was higher than both the seventh (20.87) and eighth (21.05) grade students. When compared to the national composite scores for this domain (McBeth et al., 2011), sixth (22.63), seventh (21.67), and eighth (21.41) grades of the national composite were higher than this sample. Because only half the data for this domain were collected, the sample scores cannot be compared to the ranges of high (45-60), moderate (28-44), and low (12-27) levels of environmental affect. However, using the mean from the range of possible scores (see Figure 1 on page 57) on

willingness or intent to participate in pro-environmental activities, all grade levels' scores in this sample were in the moderate range. It should also be noted that the sixth grade mean score (44.39) falls at the upper end of the range.

**Additional Findings**

To determine if the population sample equally shared the same perspectives on the survey items, two secondary analyses were conducted. First, an Independent-samples t-test was used to compare *Ecological Knowledge and Verbal Commitment* scores for males and females. Second, a one-way between-groups analysis of variance (ANOVAs) was conducted to explore the impact of grade differences on both components of environmental literacy. Tables 11 and 12 display the results of these data.

Table 11

Gender *Score Differences – Part II, Ecological Foundations & Part III, How You Think About the Environment*

| Section of *MSELS* | Gender | | | | | |
|---|---|---|---|---|---|---|
| | Females | | Males | | *t* | *df* |
| | *M* | *SD* | *M* | *SD* | | |
| Ecological Knowledge | 11.31 | 3.06 | 11.27 | 3.05 | .11 | 285 |
| *How You Think About the Environment (*Intent*) | 28.14 | 7.93 | 27.72 | 8.15 | .44 | 285 |

*Note.* *N*= 160 (Female students); N = 127 (Male students); *N=126 (Male students)

Mean scores for both sections of the *MSELS* were calculated from the female and male students (*N*=287). Dependent *t*-tests were conducted on each variable, and the data indicates no statistically significant difference among the mean scores of Ecological Knowledge ($t$ =.11, $df$ =285, $p$ >.05) or *How You Think About the Environment* ($t$ =.44, $df$ = 285, p > .05). Thus, equal variances are assumed in both variables from this sample.

Table 12

*One-Way Analysis of Variance (ANOVA) Between Grade Levels*

| Section of MSELS | *SS* | *MS* | *df* | *F* |
|---|---|---|---|---|
| Ecological Knowledge | | | | |
| Between Groups | 597.04 | 298.52 | 2 | 41.08 |
| Within Groups | 2063.96 | 7.27 | 284 | |
| How You Think About the Env. | | | | |
| Between Groups | 449.59 | 224.79 | 2 | 2.95 |
| Within Groups | 21631.33 | 76.17 | 284 | |

*Note.* $N$= 125 ($6^{th}$ grade); $N$ = 100 ($7^{th}$ grade); $N$ = 63 ($8^{th}$ grade) students.

In Table 12, the Ecological Knowledge data from one-way *ANOVA* indicate more variability between the groups than within each group ($F$ = 41.08; $df$ = 2, $p < .05$). Post-hoc comparisons using Tukey HSD indicate that the mean scores for each of the three groups are significantly different from one another at the $p<.05$ level. When comparing the mean differences at the $p<.01$ level, a significant difference was found between sixth and seventh grade students and seventh and eighth grade students but not between the sixth and eighth grade students. In calculating the effect size, the resulting Eta squared value is.02, which in Cohen's terms (1988, pp. 284-87) is considered small.

The results from a one way analysis of variance on *How You Think About the Environment* (verbal commitment) indicate more variance exists within groups than between groups ($F$ = 2.95, $df$ = 2, $p > .05$). These data suggest there is no statistically significant difference among the mean scores of the three groups from the population sample. In calculating the effect size, Eta squared = .02, which is considered small.

# Chapter V

## Discussion

This study is described as survey research (Fraenken & Wallen, 2000) where the purpose was to determine ecological knowledge and verbal intent of African American sixth, seventh and eighth grade students in a suburban environment. This study aimed to answer four broad research questions:

1. What is the extent of ecological knowledge of sixth, seventh and eighth grade African American students in a suburban setting?
2. To what extent do sixth, seventh and eighth grade African American students in a suburban setting verbally commit to pro-environmental behavior?
3. How does the environmental literacy component ecological knowledge of sixth, seventh and eighth students in this study compare to the environmental literacy component ecological knowledge of sixth, seventh and eighth grade students across the U.S.?
4. How does the environmental literacy component verbal commitment of sixth, seventh and eighth students in this study compare to the environmental literacy component verbal commitment of sixth, seventh and eighth grade students across the U.S.?

The components *Ecological Knowledge* and *How You Think About the Environment* were measured using sections II and III respectfully of the Middle School Environmental Literacy Survey *(MSELS).*

**Summary of Research Need**

Educators, policy makers, and stakeholders at global, national, and state, levels have called attention to the need for data on the status of environmental literacy. As stated earlier, there exists a lack of evidence related to the status of environmental literacy or ecological knowledge among African-American middle school students. Furthermore, requested research within all UN Member States on selected components of environmental literacy (i.e., knowledge, attitudes, values, and behavior) were approved in 1978 (*Intergovernmental Conference on Environmental Education*, UNESCO, 1977, p. 38). The U.S. Environmental Protection Agency's (EPA) National Environmental Education Advisory Council (NEEAC, 1996) also requested such information. The U.S. Environmental Protection Agency's (EPA) National Environmental Education Advisory Council (NEEAC, 1996) recommend that "a framework be developed and tools created for measuring the effectiveness of environmental education" (p. 3). This study provides valuable information and a unique opportunity for the Office of Environmental Education (OEE) to demonstrate the impact that the EPA's funding has made in the effort to increase environmental literacy. Other interests for such research include a working group convened by the Environmental Protection Agency's (EPA's) Office of Environmental Education to draft a *National EE Research Agenda* (EPA, 1998, p. 1); the National EE Advisory Council in its 2005 report to Congress (NEEAC, 2005, pp. 25, 34-35); and the National Council for Science and the Environment (2008).

Empirical data collected in this research will provide a foundation to effectively address the overall academic achievement and ecological knowledge of African American students in the sixth, seventh, and eighth grades. In addition, details provide some indication as to the extent of pro-environmental intent of this demographic. This

information can be used eventually to assess program effectiveness in the hope of raising environmental literacy across the nation.

As previously discussed, this project addresses NOAA's (2009) plan to incorporate environmental literacy into its Education Strategic Plan 2009-2029, Goal 1: An environmentally literate public supported by a continuum of lifelong formal and informal education and outreach opportunities in ocean, coastal, Great Lakes, weather, and climate sciences. "For NOAA to achieve its strategic vision, an environmentally literate and engaged public must be fostered" (p. 9). The findings generated from this project may have an effect on the design of NOAA's educational programming and benefit its academic objectives. Additionally, the final results may help identify factors that contribute to the disparities across variables that can be measured by the *MSELS*

**Summary of Methodology**

To answer the research questions, 287 sixth, seventh and eighth grade African American students from a suburban middle school in Houston, Texas were given The Middle School Environmental Literacy Survey *(MSELS).* The instrument measures six variables of environmental literacy: ecological knowledge, verbal commitment, actual commitment, environmental sensitivity, general environmental feelings, and environmental issue and action skills. The survey is divided into six sections each measuring one variable. For the purposes of this paper, only *Part II, Ecological Knowledge* and *Part III, How You Think About the Environment (intention)* were measured. Descriptive statistics were calculated for these parts, and compared to the ranges of high, moderate and low scores of environmental literacy. Finally, the scores were compared to a national study provided by McBeth et al. (2011). In addition, scores

against the high, moderate and low ranges of *ecological knowledge and verbal commitment* were determined and also compared to the national averages. *Ecological Knowledge* was the only section completed by the participants in its entirety; and the only section using the adjusted score of 60 points as an indicator of high, moderate and low levels of environmental literacy. Part III, *How You Think About the Environment* is equivalent to one-half the variables in the Environmental Affect Domain, therefore, one-half the adjusted score equaling 30 total points.

**Discussion of Results**

The results of the study provide a description of the level of environmental literacy of a group of African American middle school students on two domains, *Knowledge* and *Environmental Affect* and two variables, *Ecological Knowledge* and *Verbal Commitment.* The two variables are a significant part when identifying environmental literacy. A summary of each variable follows, including implications of the mean results. The results of this study are then compared to the mean results from a national study by McBeth et al. (2011).

**Environmental Literacy Variables**

**Ecological knowledge**. Part II of the *MSELS, Ecological Foundations,* measured ecological knowledge, a critical component in making decisions concerning the environment. This section is important because it highlights where environmental and social problems are inextricably linked (e.g., ecosystem maintenance; access to water, food, or energy resources; struggles against disease; proper disposal of/treatment of sewage or solid waste). This section contained 17 multiple-choice items; each correct answer earned one point. The range of possible scores in this section was 0-17. Descriptive statistics for grades six, seven and eight were analyzed.

The results of this study indicated that the mean score for seventh graders ecological knowledge was the highest, *M* = 13.18 or 77 % scored more than 13 of the 17 questions correct. The eighth grade mean, *M*=11.00 was more than 2 points lower than seventh grade. This could be related to the smaller sample size of participants. When the 17-item measure was compared to the national results, the mean score for eighth grade was the highest, *M* = 12.18. The national mean data indicated the seventh grade sample from this research outscored the seventh grade mean from the national scores by 1.29 points, a difference of 7 percent, indicating the suburban seventh grade students in Texas have more ecological knowledge than the national average.

**Verbal commitment**. Part III of the *MSELS, How You Think About the Environment*, measured verbal commitment, a critical component when assessing environmental literacy. This section consisted of 12 items designed to measure what the individual would be willing to do or intend to do regarding the environment. Scores in this section ranged from 12-60 with 60 representing high intent and commitment to participate in pro-environmental activity.

The mean score for sixth graders (*M* = 44.39 out of 60) was the highest followed by the eighth (*M* = 42.11 out of 60) graders. The sample from this study showed the seventh graders scored lower than the sixth (2.65 points) and eighth (2.28 points) graders. When the 12-item measure of verbal commitment was compared to the national results, the combined overall mean scores from sixth, seventh, and eighth (*M* = 42.98) grades from this sample scored slightly higher than the eighth grade (*M* = 42.83) national data. The data suggest that the participants from this study were less willing to commit to pro-

environmental behavior than their national counterparts. However, the difference was minimal.

**Summary Description of Sample**

Data for this study was collected from 287 African American sixth, seventh and eighth grade students living and attending school in a suburban setting. The survey results indicated the seventh grade sample population exhibits a higher level of ecological knowledge than the national average. The group of sixth, seventh and eighth grades together scored less than one point higher in a willingness to commit to pro-environmental behavior than their national counterparts. Analysis between males and females indicated no significant difference in either ecological knowledge or willingness to commit to positive environmental behavior.

**Links to Previous Studies**

Throughout this paper including the Introduction, Literature Review and here in the Discussion, reference has been made to a study by McBeth et al. (2011). This national study was the most relevant data available and therefore most appropriate to use as a comparison. The McBeth et al. (2011) study was the only source that included data for *ecological knowledge and verbal commitment* from a population of middle school African American sixth, seventh and eighth grade students.

Other studies focused on the term Traditional Ecological Knowledge, or TEK. This term is used to describe the knowledge held by indigenous cultures about their immediate environment and the cultural practices that build on that knowledge. Much like the ecological knowledge measured in this study, Traditional Ecological Knowledge includes an intimate and detailed knowledge of plants, animals, and natural phenomena.

However, TEK leans more toward the development and use of appropriate technologies for hunting, fishing, trapping, agriculture, and forestry, and a holistic knowledge, or "world view" which parallels the scientific discipline of ecology (Berkes 1993). TEK and local knowledge generally refer to the traditions and practices of certain regions, indigenous or local communities; it encompasses the wisdom, knowledge, and teachings of these communities. In many cases, traditional knowledge has been passed for generations from person to person.

Other studies linked to this paper were reviewed under the environmental literacy umbrella and environmental education curriculum. Such studies include the framework for assessing environmental literacy (Hollweg et al., 2011), and Carter and Simmons (2005) history and philosophy of environmental education. However, these studies may not be appropriate for comparisons due to lack of ethnic sampling and extended case studies.

**Interpretations and Implications**

Based on the results of this study, interpretations and implications can be made about the sample population. The conclusion from this study may provide guidance and insight regarding a sample of convenience with African American suburban middle school students. Overall, it is important to note that the sample population in this study (*N=287*) was restricted to one complete (*Ecological Knowledge*) and one partial (*Environmental Affect*) domain of environmental literacy. Within the *Ecological Knowledge* domain, a score is considered moderate when it falls within 21-40 range; the sample in this study scored 39.84. This indicates that despite the suburban setting,

limited outdoor access, and environmental activities, the African American students in this study are knowledgeable in ecology.

High levels of ecological knowledge scores may not be surprising because ecological concepts are threaded within the fabric of the state curriculum through life science (TEA, 2011). Students in Texas are expected to:

- explain the ecological principles that apply to interdependence between organisms and their environments and the levels of organization within an ecosystem;
- describe biotic and abiotic parts of an ecosystem in which organisms interact;
- diagram the levels of organization within an ecosystem, including organism, population, community, and ecosystem;
- observe and describe how different environments, including microhabitats in schoolyards and biomes, support different varieties of organisms;
- observe and describe biodiversity and its contribution to the sustainability of an ecosystem; role of ecological succession such as in a microhabitat of a garden with weeds;
- explore how short- and long-term environmental changes affect organisms and traits in subsequent populations;
- and recognize human dependence on ocean systems and explain how human activities such as runoff, artificial reefs, or use of resources have modified these systems.

The Environmental Affect domain was incomplete; however, the scores could be interpreted for half the domain with the verbal commitment component. The degree of verbal commitment for students living in a suburban environment scored lower than their

national counterparts. Perhaps these students would commit to more pro-environmental behavior if given the opportunity. Lower scores may indicate a need for more exposure to opportunities that support the expected behavior and commitment. With increased exposure, education and reinforcement of behavior, these students could potentially develop pro-environmental habits. Additionally, a complete analysis of this domain may have produced a different outcome.

After analyzing the environmental literacy data between genders, it appears that gender is not a significant factor in either ecological knowledge or willingness to participate in positive-environmental behavior. Both components found the females to score approximately one point higher than males. This small difference however does not indicate that females are more ecologically literate or more willing to commit to pro-environmental behavior. In fact, the closeness of the scores between males and females suggests that environmental education curriculum and instruction based on gender may be unnecessary.

In looking at curriculum and instruction, the data further suggest that grade level is not a significant factor when examining environmental literacy. The data indicate that the differences in scores do not lie within the individual groups, but rather between the groups. This is what one would expect due to developmental attributes for adolescents, however, more data would need to be collected to better interpret the levels of environmental literacy of the participant in this study. Also, it should be noted, these students attend school in an area in which district and school accountability ratings are high and learning is assessed by way of state standards. In fact, new data released in 2012

by the College Board shows the number of African-American public school students taking the SAT increased by 42 percent (TEA, 2012).

**Limitations of the Study**

Some of the limitations considered with this study included attrition for a variety of reasons. For example, students may have elected to not participate, or they may have been subject selective attrition based on unforeseen circumstances. Moreover, parents may not have given consent. There may be many reasons for parents' failure to give approval. For instance, one possibility is the failure on the student's part to deliver the request to participate. Another factor to consider is whether the district's curriculum framework did not support or integrate environmental education per se. Students may not have been familiar with the terminology on the survey, and failed to understand terminology associated with the questions. Another possibly perceived limitation is that this study did not use an experimental design; hence, no cause and effect relationships were generated.

Convenience sampling also has its limitations (Fraenkel & Wallen, 2009). Therefore, this sample of convenience may not accurately represent the target population. Although this study attempts to describe a specific group, there is no guarantee the group completing this survey is representative of all sixth, seventh, and eighth grade African American students in a suburban setting across the nation. In addition, the challenge of targeting a total group creates a situation where the results cannot be generalized with confidence due to the lack of existing data, and students outside the general testing site were excluded by the researcher.

Limitations are also present with the instrument. Although the developers report reliability for students in the sixth, seventh, and eighth grades, the specific demographics of their sample are not known. In other words, the number or percentage of African American suburban students present in the *reliability sample* are not known. Thus, the instrument may not be appropriate for the sample population used in this study.

**Recommendations for Future Research**

Based on this study, recommendations for future research can be offered. When possible, choose a time of year when data can be collected and measured for more than one domain as was shown in this study. Researchers should continue collecting data using the *MSELS* and measuring the environmental literacy variables (knowledge, verbal commitment, actual commitment, environmental sensitivity, general environmental feelings, and environmental issue and action skills) from African American populations. By using existing instruments, comparisons can be made among the groups to gain additional insight to the level of environmental literacy of middle school students. These comparisons may help determine whether environmental education efforts to implement environmental literacy are successful within the public school system. Finally, studies should be conducted to identify other factors that influence the various levels of environmental literacy such as culture, socio-economic status, education, and developmental stages. Once identified, studies can be designed to address these factors.

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# Appendix A

## Middle School Environmental Literacy Survey (MSELS) Instrument

For information concerning the Middle School Environmental Literacy Survey *(MSELS)*instrument used in this study, please contact The Center for Instruction, Staff Development, and Evaluation (CISDE) at 618-457-8927, cisde@midwest.net.

# Appendix B

## Assent and Consent Forms

**UNIVERSITY OF HOUSTON**
**CONSENT TO PARTICIPATE IN RESEARCH**

**PARENTAL PERMISSION**

Dear Parents:

Your child is being invited to participate in a research project conducted by Désirée Heyns, a science lab instructor at Carroll Elementary School-SheldonISD, and doctoral candidate in the College of Education at the University of Houston. This information is part of her requirements to obtain a doctorate degree in Science Education. Ms. Heyns is under the direction of Dr. John Ramsey, science education faculty at the University of Houston.

**PROJECT TITLE**: Ecological Knowledge and Attitudes of African American Students in a Suburban Texas Middle School.

**NON-PARTICIPATION STATEMENT**
Your child's participation is voluntary and you or your child may refuse to participate or withdraw at any time without question or penalty or loss of benefits to which your child is otherwise entitled. Your child may also refuse to answer any question. Your child's decision to participate or not, or to withdraw your participation will have no effect on their standing or grade.

**PURPOSE OF THE STUDY**
The purpose of the study is to gather information about students' knowledge and attitudes towards different environmental processes and issues. The results gathered from your child and his/her peers will become part of a national database of information regarding how individuals view the environment as well as their knowledge on problems concerning the environment.

**PROCEDURES**
Your child will be one of approximately 900 students asked to participate in this project. Your child will respond to 33 questions that are about the environment including knowledge of and attitudes towards different environmental processes and issues. The survey will take approximately 25 minutes and will not become part of your child's grade.

**CONFIDENTIALITY**

Your child's participation in this study is anonymous and their name will not appear on any document other than this permission form. There will be no way to link your child's name to the survey he or she completes. All participants will be directed not to write their name or other identifying information on the materials returned to the principal investigator.

**RISKS/DISCOMFORTS**

There are no risks or discomforts associated with the study.

**BENEFITS**

Although your child will not receive a grade on this survey, he or she will have a chance to become aware of his/her knowledge of environmental issues and attitudes. His/her participation may also help educators better understand students' decisions concerning the environment or if more environmental education activities are necessary.

**ALTERNATIVES**

Participation in this project is voluntary and the only alternative to this project is nonparticipation.

**PUBLICATION STATEMENT**

The results of this study may be published in professional and /or scientific journals. It may also be used for educational purposes or for professional presentation. However, no individual subject will be identified. Your child's information will not be given to anyone.

---

**SUBJECT RIGHTS**

1. I understand that parental consent is required of all persons under the age of 18 participating in this project. I understand that my child (student) will also be asked to agree to participate.

2. I understand that parental consent is required of all persons under the age of 18 participating in this project. I understand that my child (student) will also be asked to agree to participate.

3. All procedures have been explained to me and I have been provided an opportunity to ask any questions I might have regarding my child's (student's) participation.

4. Any risks and/or discomforts have been explained to me.

5. Any benefits have been explained to me.

6. I understand that, if I have any questions, I may contact Désirée Heyns at 832-661-4407. I may also contact Dr. John Ramsey, faculty sponsor, at 713-743-4996.

7. I have been told that my child or I may refuse to participate or to stop his/her participation in this project at any time before or during the project. My child may also refuse to answer any question.

8. ANY QUESTIONS REGARDING MY CHILD'S RIGHTS AS A RESEARCH SUBJECT MAY BE ADDRESSED TO THE UNIVERSITY OF HOUSTON COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS (713-743-9204).

9. All information that is obtained in connection with this project and that can be identified with my child (student) will remain confidential as far as possible within legal limits. Information gained from this study that can be identified with my child (student) may be released to no one other than the principal investigator. The results may be published in scientific journals, professional publications, or educational presentations without identifying my child (student) by name.

NAME OF CHILD (STUDENT):
_____

I agree to allow my child (student) to participate in this research project:

YES_____ NO_____

Signature of
Parent/Guardian:_____

## Appendix C

# Permission to use *MSELS* Instrument

***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 10, 2014

Désirée Heyns
212 Elm Street
Highlands, TX 77562-2522

Dear Désirée:

This letter constitutes permission for you to use the Middle School Environmental Literacy Survey in your doctoral study. 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 study will investigate the ecological knowledge and attitudes of African American middle school students in a suburban setting? You have indicated that you will restrict access to the MSELS to those who are involved in the study 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 wish you continuing 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 D

## School District Permission to Conduct Research

November 11, 2013

Dr. John Ramsey
Désirée Heyns, M.S.Ed.
University of Houston
256 Farish Hall
Houston, TX 77204-5027

Dear Dr. Ramsey and Ms. Heyns:

The Sheldon Independent School District (SISD) is pleased to approve the research study titled, "Ecological Knowledge and Attitudes of Middle School African-American Students in Suburban Texas Classrooms". The purpose of the study is to help fill the gap about suburban middle school students' knowledge and attitudes towards different environmental processes and issues. Data collection will begin November, 2013 and the projected date of report submission is June 31, 2014.

Approval to conduct this study is contingent on your meeting the following conditions:

- Data collection will not interfere with instruction time.
- The participants will be from C. E. King Middle School, grades 6-8.
- All participants must have a completed /signed consent form, which will be made available to SISD administration upon request.
- District personnel and students are not identified in the process or final reports.
- The study involves no expense to the district.
- The district receives copies of the final report within 30 days of its completion.

Any changes or modifications to the current proposal must be submitted to the Department of Instructional Services for approval. Should you need additional information or have any questions concerning the process, please contact me at (281) 727-2046.

Sincerely,

Dr. Joan Bowman
Associate Superintendent
Sheldon ISD
Houston, Texas 77044

# Appendix E

## Permission to Conduct Reseach in School

UNIVERSITY OF HOUSTON
CONSENT TO PARTICIPATE IN RESEARCH
Administrator Consent

Mr. Hernandez,

I am very excited to extend you and C. E. King Middle School, the opportunity to participate in research in conjunction with the University of Houston (headed by Désirée Heyns and Dr. John Ramsey) and the Center for Instruction, Staff Development and Evaluation in Carbondale, Illinois. The data collected will become part of a National Evaluation of Environmental Literacy, and it may be used to aid in decision making regarding science education. The purpose of this letter is to obtain your permission to collect data from your 6th, 7th, and 8th grade students. Below is a short description of procedures to be done.

CONFIDENTIALITY
The confidentiality of the students is of utmost importance to all involved. The students' names will *not* be used and will *not* be made available to anyone. Each survey given to the students will be assigned a number. No names will be used.

PARENTAL CONSENT
Each student will be given a permission form to give to his/her parents that must be signed in order to participate. Only data collected from students with parental permission will be used in the study. The permission letter is attached.

PURPOSE OF THE STUDY
The purpose of the study is to gather information about the current state of ecological knowledge and attitudes of American youth. Historically, students living in suburban areas attending suburban schools have not been included in evaluation efforts. This study is aimed at getting that information into the current national evaluation.

PROCEDURE
Collecting data will include having the students complete a 33 question survey about their ecological knowledge and attitudes. The survey will require approximately 20 minutes to complete. Each survey will be numbered and NO names will be used.

I, Désirée Heyns, am requesting your permission to administer the ecological knowledge and environmental attitude sections of the Middle School Environmental Literacy Survey to your students. I am anxious to process and collect data so the information can be represented in the current environmental literacy literature. The spring 2014 semester would be an ideal time, if this is convenient for you and your school.

By signing below, I am pledging that I will collect data with integrity and will not violate the confidentiality of you or your students.

Désirée Heyns, researcher
University of Houston

By signing below, you agree to allow me to administer the survey. If you have any questions, please feel free to contact me at (832) 661-4407 or dgheyns@uh.edu I sincerely thank you.

Roberto Hernandez, Principal

# Appendix F

## Human Subjects Approval

UNIVERSITY of HOUSTON

DIVISION OF RESEARCH

April 9, 2014

Ms. Desiree Heyns
c/o Dr. John M. Ramsey
Curriculum and Instruction

Dear Ms. Desiree Heyns,

The University of Houston Committee for the Protection of Human Subjects (1) reviewed your research proposal entitled "Ecological Knowledge and Attitudes of African American Students in a Suburban Texas Middle School" on February 21, 2014, according to federal regulations and institutional policies and procedures.

At that time, your project was granted approval contingent upon your agreement to modify your protocol as stipulated by the Committee. The changes you have made adequately fulfill the requested contingencies, and your project is now **APPROVED**.

- **Approval Date: April 9, 2014**
- **Expiration Date: April 8, 2015**

As required by federal regulations governing research in human subjects, research procedures (including recruitment, informed consent, intervention, data collection or data analysis) may not be conducted after the expiration date.

To ensure that no lapse in approval or ongoing research occurs, please ensure that your protocol is resubmitted in RAMP for renewal by the **deadline for the March 2015** CPHS meeting. Deadlines for submission are located on the CPHS website.

During the course of the research, the following must also be submitted to the CPHS:

- Any proposed changes to the approved protocol, prior to initiation; AND
- Any unanticipated events (including adverse events, injuries, or outcomes) involving possible risk to subjects or others, within 10 working days.

If you have any questions, please contact Alicia Vargas at (713) 743-9215.

Sincerely yours,

Daniel O'Connor

Dr. Daniel O'Connor, Chair
Committee for the Protection of Human Subjects (1)

PLEASE NOTE: All subjects must receive a copy of the informed consent document, if one is approved for use. All research data, including signed consent documents, must be retained according to the University of Houston Data Retention Policy (found on the CPHS website) as well as requirements of the FDA and external sponsor(s), if applicable. Faculty sponsors are responsible for retaining data for student projects on the UH campus for the required period of record retention.

Protocol Number: 14266-01 Full Review__X__ Expedited Review____