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ABSTRACT

ENVIRONMENTAL LITERACY OF SEVENTH-DAY ADVENTIST TEACHERS IN THE PAROCHIAL SCHOOLS OF THE FLORIDA CONFERENCE OF SEVENTH-DAY ADVENTISTS

by

Michael Murdoch

Chair: James Tucker

ABSTRACT OF GRADUATE STUDENT RESEARCH

Dissertation

Andrews University

School of Education

Title: ENVIRONMENTAL LITERACY OF SEVENTH-DAY ADVENTIST TEACHERS IN PAROCHIAL SCHOOLS OF THE FLORIDA CONFERENCE OF SEVENTH-DAY ADVENTISTS

Name of researcher: Michael Murdoch

Name and degree of faculty chair: James Tucker, Ph.D.

Date completed: September 2012

Problem

In the United States, there is an environmental literacy problem. Americans possess limited knowledge about the environment and environmental issues, and they display limited positive action regarding the environment in which they live. Moreover, there is a debate whether a Christian's interpretation of Gen 1:28 leads either to a lower or to a higher environmental literacy. Does the Seventh-day Adventist teaching community reflect these problems? These are the problems which this dissertation seeks to help solve.

Purpose

The purpose of this study was to attempt to assess the environmental literacy of a group of teachers in Seventh-day Adventist (SDA) parochial schools who teach in the

schools of the Florida Conference of Seventh-day Adventists, to determine what the level of environmental literacy is, and to discover the interpretations that these educators have of Gen 1:28. The study specifically looked at four dimensions of these teachers' environmental literacy: (a) teachers' attitudes toward the environment, (b) teachers' feelings toward their roles in causing environmental change, (c) teachers' interactions with their environment, and (d) teachers' level of knowledge about the environment and issues involved. The teachers' interpretations of Gen 1:28 were also studied. Thus, this study seeks to assist in helping to solve both the environmental literacy and praxis deficits in America.

Method

This research employed a survey research method. The teachers of the parochial schools of the Florida Conference of Seventh-day Adventists were asked to respond to the survey. A census survey was utilized to conduct a study of the teachers' environmental literacy and their interpretation of Gen 1:28. Data analysis included descriptive statistics of the results, correlational analysis to determine relationships between the variables, analysis of variance (ANOVA) to determine significance of relationships between variables, and the PASW® general linear model (GLM), which includes ANOVA and regression, to test for interaction effects between demographic variables. Open-ended questions about Gen 1:28 were analyzed in terms of the answers to the research questions for emerging similarities among the participants' responses. The resulting patterns and themes were examined in relationship to answers on the WELS.

Results

The teachers of the parochial schools operated by the Florida Conference of Seventh-day Adventists who participated in the study showed nominal environmental literacy. The mean total environmental literacy score was 66%. The subscale that the participants scored the highest on was the cognitive subscale (76%), followed by the affective subscale (73%) and, lastly, the behavioral subscale (49%). As suggested by the scores, these teachers have room for improvement. A significant difference in cognitive subscale scores between White, Non-Hispanics, and Hispanics was discovered. The study discovered four themes in teachers' interpretations of Gen 1:28. The themes included: responsibility, take care of the environment, earth as a gift, and self-serving.

Conclusions

Environmental-literacy research needs to be conducted with more groups of Seventh-day Adventist (SDA) teachers and the general population of SDAs. The present study provides a baseline on which to build studies. More research could further explore the reason for the apparent disconnect between what is known and felt as compared to what is actually done. This study could be useful in the advancing of discussion about the need for environmental education programs in teacher education and the development of such programs. Before this study, the data did not address the effect that teachers' religious beliefs have on environmental literacy. Similarly, the effect of ethnicity on environmental literacy has rarely been looked at. This study began to address differences based on ethnicity. Studies could be done on the amount and kind of environmental education preparation that teachers receive and the effects these have on teachers' environmental literacy.

Andrews University

School of Education

ENVIRONMENTAL LITERACY OF SEVENTH-DAY ADVENTIST TEACHERS IN THE PAROCHIAL SCHOOLS OF THE FLORIDA CONFERENCE OF SEVENTH-DAY ADVENTISTS

A Dissertation

Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

Michael Murdoch

September 2012

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APPROVAL BY THE COMMITTEE:

Chair: James Tucker	Dean, School of Education James R. Jeffery
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Member: Robson Marinho	
Member: Kristin Stehouwer	
External: Carleton Swafford	Date approved

To

Debbie, Carson, and Campbell

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CHAPTER ONE

INTRODUCTION

Foreword

For those of us in the Christian community, the biblical passage that may be the starting point for a discussion of our role as it relates to the environment is,

> God blessed them and said to them, Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground. (Gen 1:28, NIV)

I believe that the Christian community's interpretation of these words sets the tone for its relationship with the natural world.

The phrase, "Be fruitful and increase in numbers," is often interpreted as having to do with procreation of the human race, but this phrase has also been interpreted as having humans be good managers of the natural world God created. A group of Judeo-Christian scholars who published the Cornwall Declaration on Environmental Stewardship proposed that the phrase deals with humans and God making "provision for our temporal well-being and enhancing the beauty and fruitfulness of the rest of the earth" (Barkey, 2000, p. xiv). Consequently, the phrase could be interpreted as a proclamation by God to Christians requiring them to take an active role in practicing good stewardship of the natural world.

"Fill the earth and subdue it" does not have to be interpreted to mean giving humanity permission to abuse the environment, but instead can be interpreted to mean

using the earth's resources wisely. An insightful comment from Barkey's (2000) book, *Environmental Stewardship in the Judeo-Christian Tradition,* is:

> The Hebrew for conquering or subduing, (i.e. "koveish") clearly distinguishes between annihilating and conquering. The former is a verb for utterly destroying one's enemy. The latter refers to leaving one's enemy's resources and abilities intact and even enhancing them, but redirecting them for one's own end. That is what we are told to do with the natural world. We may not destroy, but we may use them in every possible beneficial manner. (p. 12)

The implication is Christians are to avail themselves of the world without causing harm to it.

The view I will take in this study is that God expected humans to take care of the earth, which he created for them. Thus, after he created humans in his image, God told them to rule over the earth.

> Then God said, let us make man in our image, in our likeness, and let them rule over the fish of the sea and the birds of the air, over livestock, over all the earth, and over all the creatures that move along the ground. (Gen 1:26, NIV)

The concept of "ruling over" as related to this text in the Bible is described by Wenham (1987) as "to rule nature as a benevolent king, acting as God's representative over them and therefore treating them in the same way as God who created them" (p. 33). A benevolent king takes care of his subjects. Thus, humans, who are made in the image of God of a benevolent ruling king, are to take care of the environment God has given us. Barkey (2000) warns, "If man executes dominion in a way that ultimately destroys nature's creative potential or denies the human family the fruits of creation, such actions constitute an offense against God's original plan of creation" (p. 31).

In Isa 45:18, it is made clear that the world was made to be inhabited. The Bible also says, "The Lord God took man and put him in the Garden of Eden to work it and take care of it" (Gen 2:15, NIV).

From this perspective, human rule over creation consequently has human welfare as the focus, and the well-being of the world resources as a top priority. If we are going to have the world take care of us, we need to take care of it. Interdependence is vital.

Background of the Problem

Relative to the environment, there is a knowledge problem in the United States. In general, Americans possess a limited knowledge about the environment in which they live. Coyle (2005) states:

> 45 million Americans think the ocean is a source of drinking water. One hundred million Americans think that aerosol cans are the main source of CFC's going into the atmosphere (in truth, CFC's in spray cans were completely banned in 1978) and a similar number think that disposable diapers are the leading problem in landfills (they actually account for about 1% of what ends up in land fills; paper products are by far the larger problem). (p. 20)

The development of an environmental literate citizenry, which leads to environmentally-responsible behavior, is a goal of what I will refer to in this study as environmental education (EE). Disinger (2005), a leader in the development of environmental education, summarizes the varied definitions of EE, of which key components are critical thinking skills, problem solving, and effective decision-making. All lead to the development of environmental literacy (EL). The term "environmental literacy" was created to describe desirable characteristics and actions (Disinger & Roth, 1992). It involves having knowledge about the environment, along with having sensitivity to the environment, possessing the skills to act according to one's attitudes and values, as well as making the personal investments necessary and taking responsibility about one's actions.

Teachers with suitable environmental literacy can widen the impact of environmental education broadly and effectively (UNESCO, 1988). This dissertation endorses this value. Nevertheless, what teachers teach in environmental education may be significantly predisposed by their own environmental literacy.

Due to the increased concern for the environment, EE is beginning to receive more attention in the media, but is still not a high priority in American schools (Cole, 2007; Ernest, 2007; Wilson & Smith, 1996). As stated in the literature, part of the problem is that EE should be interdisciplinary, but many teachers feel that it should be taught in the science classes (Cole, 2007; Wade, 1994) and do not feel they have room in their already packed curriculum.

Successful EE is dependent on the classroom teacher (Ramsey, Hungerford, & Volk, 1992). Many do not know how to teach it, because EE is not typically included in their training (Buethe & Smallwood, 1986) or generally referred to in professional journals of education (Wilson & Smith, 1996).

Teachers' classroom presentations are affected greatly by their knowledge base and affective relationship to the subject matter being presented (Buethe & Smallwood, 1986). This means that if teachers do not have the knowledge and/or skill to incorporate EE into the program of study, their students could be limited in reaching significant levels of environmental literacy.

There is limited research on teachers' environmental literacy, even though environmental literacy is an important goal of EE. The limited research that has been done shows that teachers have limited environmental literacy. In the United States, only a few states' teachers have even been surveyed. Buethe and Smallwood (1986) studied

teachers in Indiana. Todt (1995) looked at Ohio teachers. Owens (2000) looked at urban teachers in a southern state. Champeau's (1997) study of Wisconsin teachers was the most comprehensive study that I found of any one state's teachers.

The lack of environmental literacy is not just an American problem. Cutter (2002) explored knowledge and attitudes of Australian elementary teachers and found them lacking. Hsu (1997) studied responsible environmental behaviors of secondary teachers in Taiwan and discovered that they also had limited environmental literacy. More research is needed to better evaluate teachers' environmental literacy.

Two statewide surveys and one national survey have been conducted to discover the environmental literacy of the citizenry. All three found limited environmental literacy. Coyle's (2005) study, the national survey, reported differences based on gender, age, and level of education. The same was found in Pennsylvania (Johnson & Smith-Sebasto, 2000) and Minnesota (Murphy, 2002), along with differences based on socio-economic class and urban versus suburban and rural living locations.

Owens (2000) studied middle-school teachers from a southern state and reported differences in environmental literacy due to gender, racial-ethnic background, years of teaching, and subject area taught. The Owens study seemed to demonstrate that teachers' environmental literacy parallels that of society in that it was not well developed.

For many decades, it has been suggested that Judeo-Christian theology is antagonistic to EE, since it teaches "dominion" over the earth. Lynn White (1967) in his classic article, "The Historical Roots of Our Ecological Crisis," argues that Judeo-Christian documents are anti-environment, because of the prominence of the separation of man from nature. According to White, the individuals' views and the way they

interact with the environment are tied in their religious system of belief, and that the Judeo-Chritisian ethic gives humans the right to do as they see fit with the environment. Many authors seem to support this thesis (Eckberg & Blocker, 1996; Hand & Van Liere, 1984; Worster, 1994).

Hitzhusen (2007) argues that this is not true, and that actually the opposite is more accurate. Many "proofs" of the "anti-environment" tended to be related to political views, rather than religious views. Hitzhusen goes so far as to say that the "dominion" idea has very little impact of environmental views. There are some, such as Barkey (2000), who suggest a belief that there is a principle of stewardship implied in the opening book of Genesis.

This conflict over "master of nature" versus "stewardship of nature" could have a direct bearing on environmental literacy. A "master of nature" belief system would lead to a lower environmental literacy, whereas a "stewardship of nature" belief system would lead to a higher environmental literacy.

In 1996, the SDA church released a "Statement on Stewardship of the Environment" (General Conference of Seventh-day Adventists, 1996). This statement advocates "reformation of lifestyle . . . based on respect for nature, restraint in the use of the world's resources, reevaluation of one's needs, and reaffirmation of the dignity of created life" (p. 1). The ideas of respect for nature, restraint in use, evaluations of one's needs, and dignity of life are key components of EE. The SDA parochial education system serves the important purpose of educating the youth of the church. Therefore, it is reasonable to assume that the denomination has an interest in how well its statement of faith related to stewardship is being supported by the teachers in its schools.

Statement of the Problem

In the United States, there is an environmental literacy problem. Americans possess limited knowledge about the environment and environmental issues, and they display limited positive action regarding the environment in which they live. Moreover, there is a debate whether a Christian's interpretation of Gen 1:28 leads either to a lower or to a higher environmental literacy (Hitzhusen, 2007). Does the Seventh-day Adventist teaching community reflect these problems? These are the problems which this dissertation seeks to help solve.

Purpose of the Study

The purpose of this study was to attempt to assess the environmental literacy of a group of teachers in Seventh-day Adventist (SDA) parochial schools who teach in the schools of the Florida Conference of Seventh-day Adventists, to determine what the level of environmental literacy is, and to discover the interpretations that these educators have of Gen 1:28. The study specifically looked at four dimensions of these teachers' environmental literacy: (a) teachers' attitudes toward the environment, (b) teachers' feelings toward their roles in causing environmental change, (c) teachers' interactions with their environment, and (d) teachers' level of knowledge about the environment and issues involved. The teachers' interpretations of Gen 1:28 were also studied. Thus, this study seeks to assist in helping to solve both the environmental literacy and praxis deficits in America.

Significance of the Study

A review of current literature suggests that this will be the first such study to look at the environmental literacy of SDA teachers. If the teachers' environmental literacy is found to be limited, the results of this research may be able to assist in identifying ways to develop teachers' environmental literacy, which would improve teacher preparedness.

Research Questions

The core research questions of this study are:

1. What levels of environmental literacy do participating teachers show as measured by the Wisconsin Environmental Literacy Survey (WELS) based on their (a) gender, (b) racial-ethnic backgrounds, (c) age, (d) number of years teaching, (e) area of specialty, and (f) self-evaluation of environmental literacy?

2. What interactions, if any, are shown between these factors, and how do these factors relate to the subscales used in the WELS?

3. What interpretations of Gen 1:28 do participating teachers have?

Conceptual Framework

In 1969, environmental education began to take shape with the publication of the *Journal of Environmental Education* and was followed in 1970 by the first Earth Day and passage of the National Environmental Education Act. Many environmental educators point to two important documents: The Belgrade Charter (United Nations Educational, Scientific and Cultural Organization—United Nations Environment Programme [UNESCO-UNEP], 1976) and The Tbilisi Declaration (UNESCO, 1978). On page 2 of the Belgrade Charter the following goal statement is made:

> 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 preventions of new ones.

A couple years later, the first global intergovernmental conference on environmental education approved the Tbilisi Declaration. This declaration, coming from the Belgrade Charter, put forward that the basic aim of environmental education is to guide to an understanding of the complex nature of both the natural and built environments caused from the interaction of their social, economics, biological, physical, and cultural aspects, along with help in gaining the knowledge, attitudes, values, and practical skills to take part in a responsible and effective way in predicting and solving environmental problems, and also in the management of the quality of the environment (UNESCO, 1978).

Hungerford, Peyton, and Wilke (1980) used these two statements to suggest the superordinate goal of environmental education: "to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment" (p. 44).

One of the earliest efforts to develop a framework based on the literature was done in the late 1970s (Harvey, 1976). This framework included cognitive, affective, and psychomotor domains, and reflected the fact that environmental literacy developed over time. This framework identified three levels to environmental literacy: literate, competent, and dedicated citizen (Harvey, 1976).

Theory and practice have been advanced significantly since the 1980s thanks to a body of research and evaluation studies (e.g., Coyle, 2005; Iozzi, 1984; Rickinson, 2001; 2010; Zelezny, 1999).

A different framework was developed by Roth and others in 1992 which included the following three levels of environmental literacy: nominal, functional, and operational (Disinger & Roth, 1992; Roth, 1992). This framework also defined four broad components of environmental literacy similar to the categories used in the Tbilisi framework: knowledge, affect, skills, and behavior (Roth, 1992).

Another framework was created to help in the development of several environmental literacy assessment instruments (Wilke, 1995). This framework defined four clusters of environmental literacy components: cognitive dimensions, affective dimensions, additional determinants of environmentally responsible behavior, and person and/or group involvement in environmentally responsible behavior.

The concept of "environmental literacy" continues to develop as new parts emerge for consideration. This concept will need to be continually updated as new relevant constructs are discovered.

The conceptual framework chosen for this study is that of Roth (1992). Environmental literacy is a combination of ecological/environmental knowledge, attitudes and feelings toward the environment, and behaviors (interactions) with the environment. One is not environmentally literate or environmentally illiterate. There is a spectrum between the two extremes.

General Method

The importance of teachers to the process of achieving environmental literacy leads to the question of how to assess for environmental literacy. Wisconsin is a state that has done considerable research on EE and environmental literacy and has developed measurement instruments and measured the environmental literacy of its fifth and 11th-grade students.

The instrument that I used for this study was the Wisconsin Environmental Literacy Survey (WELS). The WELS was developed in 1994 by the Wisconsin Center for Environmental Education (WCEE) and has been reported to be a reliable and valid measure of environmental literacy for students (Champeau, 1997) and teachers (Owens, 2000; Todt, 1995). The WELS consists of three parts: a multiple-choice test of environmental knowledge; a Likert-style survey of environmental attitudes; and a Likert-style, self-reporting of environmental behavior.

In my study, a series of open-ended questions based on the interpretation of Gen 1:28 was added to the end of the WELS.

Limitations

The definition of environmental literacy used in this study included environmental knowledge, attitudes, behavior, and skills. The WELS claims to measure only the first three of these.

The WELS was originally planned to test the environmental literacy of 11th-grade students in the state of Wisconsin. Both Todt (1995) and Owens (2000) determined that the instrument is also appropriate for use with teachers.

I am a member of the Seventh-day Adventist church and an employee of the Florida Conference of Seventh-day Adventists.

Delimitations

This study dealt with the environmental literacy of Seventh-day Adventist teachers in the parochial schools operated by the Florida Conference of Seventh-day Adventists. Since this study was limited to the teachers of this conference, the findings should not be generalized for other teachers in other conferences or other school systems, public or private.

Assumptions

Environmental literacy is an attribute that can be measured, but cannot be measured through the use of one variable. Using three subscales (affective, behavioral, and cognitive) provided for the measurement of environmental literacy.

Teachers are an important part in the success of EE and development of environmental literacy.

The participants provided responses that were honest and free from social desirability response bias.

Responses were not affected by the design of the survey.

The teachers being surveyed were all members of the Seventh-day Adventist church and are assumed to bring with them an understanding of the topic that is inherent in the beliefs of the church.

Definitions of Terms

Conference: The unit of organization of Seventh-day Adventist churches within a state, province, or territory (North American Division [NAD], 2010).

Environmental Education: An interdisciplinary, integrated method concerned with resolution of moral conflicts related to the man-environment relationship, through the development of a citizenry with awareness and understanding of the environment, both natural and man-altered. Further, this citizenry will be able and willing to apply enquiry skills, and apply decision-making, problem-solving, and action strategies toward achieving/maintaining homeostasis between quality of life and quality of environment (Harvey, 1976).

Environmental literacy:

> The capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems. . . . Environmental literacy should be defined . . . in terms of observable behaviors. That is, people would be able to demonstrate in some observable form what they have learned –their **knowledge** of key concepts, **skills** acquired, **attitude** and **behavior** toward issues. (Emphasis in original; Disinger & Roth, 1992, p. 3)

Teacher: A certified instructional professional employed by the conference to serve the educational program of the conference's local parochial school (NAD, 2010).

Organization of the Study

The foreword is intended to show the scriptural basis for being environmentally literate. The present chapter has introduced the apparent existing problem of teachers' limited environmental literacy and its implications for student environmental literacy. This chapter has also introduced the study in terms of significance and methodology.

Chapter 2 contains a review of the literature situating the issue of teachers' limited environmental literacy, a survey of definitions of environmental literacy, studies

that have attempted to operationalize the measurement of environmental literacy in different populations, and a review of literature attempting to suggest a relationship between a person's spiritual/biblical orientation and his or her environmental literacy.

Chapter 3 describes the methods used in this mixed quantitative and qualitative study that used an adaptation of the Wisconsin Environmental Literacy Survey (WELS).

Chapter 4 presents the results of the study. Data are presented in both narrative and graphical format.

Chapter 5 discusses the conclusions of the study and provides recommendations for practice as well as additional research.

CHAPTER TWO

LITERATURE REVIEW

Introduction

Many feel that what we are exposed to becomes an important part of our life. Life experiences are important to our development as a person. Baba Dioum, African environmentalist, in his speech to the World Conservation Union in 1968 provided the following quote, "In the end, we will conserve only what we love. We will love only what we understand. We will understand only what we are taught" (Main, 2004, p. 11). Richard Louv (2005) in his book, *Last Child in the Woods*, reinforces the idea of connection between time spent in nature and a concern for the environment. In a foundational paper on environmental education curriculum development, Hungerford et al. (1980) suggest as the superordinate goal "to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving, and/or maintaining a dynamic equilibrium between quality of life and quality of the environment" (p. 43).

Environmental Education and Environmental Literacy

Many environmental educators credit Rachel Carson's two books, *The Sense of Wonder* (Carson, 1965) and *Silent Spring* (Carson, 1962), for triggering the modern environmental movement started in the 1960s (Chepesiuk, 2007). In *The Sense of Wonder*, she encourages adults to take children out into nature and, in doing so, produce

an awe that could lead to taking better care of the earth. *Silent Spring* brought the world's attention to the dangers of pesticides, specifically DDT, and the ecological damage that could result from their use.

In 1969, the first formal definition of environmental education (EE) was proposed by Stapp and his students:

> Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution. (Stapp et al., 1969, pp. 30-31)

It began to take shape with the publication of the *Journal of Environmental Education* and was followed in 1970 by the first Earth Day and passage of the National Environmental Education Act. Harvey (1976) attempted to determine if there existed an established definition. He found that there was not one, so he undertook its development. By using key-word and key-phrase analysis of existing definitions, he developed the following "mediating" definition:

> [Environmental education is] an interdisciplinary, integrated process concerned with resolution of values conflicts related to the man-environment relationship, through development of a citizenry with awareness and understanding of the environment, both natural and man-altered. Further, this citizenry will be able and willing to apply enquiry skills, and implement decision-making, problem-solving, and action strategies toward achieving/maintaining homeostasis between quality of life and quality of environment. (p. 158)

Many environmental educators point to two important documents: The Belgrade Charter (United Nations Educational, Scientific and Cultural Organization-United Nations Environment Programme [UNESCO-UNEP], 1976) and The Tbilisi Declaration (UNESCO, 1978). On page 2 of the Belgrade Charter the following goal statement is made:

> 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 preventions of new ones. (UNESCO-UNEP, 1976, p. 2)

A couple years later, the first global intergovernmental conference on environmental education approved the Tbilisi Declaration. This declaration, coming from the Belgrade Charter, put forward that the basic aim of environmental education is to guide to an understanding of the complex nature of both the natural and built environments caused from the interaction of their social, economics, biological, physical, and cultural aspects, along with help in gaining the knowledge, attitudes, values, and practical skills to take part in a responsible and effective way in predicting and solving environmental problems, and also in the management of the quality of the environment (UNESCO, 1978).

Hungerford et al. (1980) used these two statements to suggest the superordinate goal of environmental education is "to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment" (p. 44).

Through the years since, the definition of EE has become more refined, but agreement on a single definition has still not been reached. The definitions used today continue to include such terms as *aware*, *motivated,* and *knowledgeable*, but include language dealing with responsible actions, critical thinking, and responsible decision-making. Nevertheless, the less complex Stapp definition is the most commonly cited and is most often used by practitioners (Disinger, 2001).

The formation of an environmentally literate citizenry is the major goal of EE (Culen, 1998; Disinger & Roth, 1992; Harvey, 1976; McBeth & Volk, 2010; Moody & Hartel, 2007). Hungerford et al. (1980) emphasized using environmental education curricula to increase environmental literacy. They suggested these curricula needed to be more than just a basic understanding of the environment. They came up with four goal levels to produce an environmentally literate citizenry. Level I, ecological-foundations curricula, focused on building ecological-foundational knowledge in areas such as individuals and populations, biogeochemical cycling, succession, and the ecological impacts of human's activities. Level II, conceptual-awareness curricula, would help "receivers" develop awareness of how the environment is viewed and valued. Level III, investigation and evaluation curricula, would allow "receivers" to investigate environmental issues/problems and evaluate alternate solutions to those issues/problems. Lastly, Level IV, environmental-action skills curricula, would teach "receivers" the skills necessary for them to take action.

Disinger and Roth (1992) recognize Charles E. Roth with coining the term *environmental literacy* in 1968. President Nixon used the term in his August 1970 Environmental Message to Congress:

> 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. (Disinger & Roth, 1992, p. 11)

Disinger and Roth (2002) also note that although the term "environmental literacy" has been used for decades by environmental-education experts, it still lacks a precise definition. They suggest the following definition:

> Environmental literacy should be defined . . . in terms of observable behaviors. That is, people should be able to demonstrate in some observable form what they have learned—their knowledge of key concepts, skills acquired, disposition toward issues, and the like. (p. 3)

Roth (1992) provided descriptions of individuals at his three proposed levels of environmental literacy:

> **Nominal environmental literacy** indicates a person able to recognize many of the basic terms used in communicating about the environment and able to provide rough, if unsophisticated, working definitions of their meanings. . . . **Functional environmental literacy** indicates a person with a broader knowledge and understanding of the nature of and interactions between human social systems and other natural systems. . . . **Operational literacy** indicates a person who has moved beyond functional literacy in both breadth and depth of understandings and skills who routinely evaluates the impacts and consequences of actions. (emphasis in original; p. 18).

Measuring Environmental Literacy

For my study, several instruments were considered. The first instrument considered, Florida Environmental Literacy Survey (FELS), was used by Bogan and Kromrey (1996) to measure the environmental literacy of high-school students in the state of Florida. It was divided into six subtests, which included environmental knowledge, ecological attitude, necessary environmental behavior, active environmental behavior, political action skills, and perception of most critical environmental concerns. Two major limitations of the FELS were its purposeful design to evaluate educational outcomes in the state of Florida and its specificity of environmental problems of that state. These aspects of the instrument limited the ability to use the survey in other parts of the country and to potentially generalize any results to other parts of the country.

The second instrument considered for use was the Middle School Environmental Literacy Instrument (MSELI). In reviewing the dissertation by McBeth (1997) detailing

the development of MSELI, the instrument was determined to not measure specifically the aspects of environmental literacy as outlined for my study. Also, the questions might not be appropriate for use with adults.

The instrument that I selected to use in this study to assess teachers' environmental literacy was the Wisconsin Environmental Literacy Survey (WELS) (Wisconsin Center for Environmental Education [WCEE], 1994). It was selected because the instrument was determined to measure specifically the aspects of environmental literacy as outlined for my study and had also been shown to be appropriate for use with adults. The WELS was designed as a three-part paper-and-pencil survey including two Likert-type parts (a self-reporting behavior instrument, and an attitude survey) and a multiple-choice test of environmental knowledge. The instrument was originally designed to assess the environmental literacy of 11th-graders in the state of Wisconsin, but two researchers (Owens, 2000; Todt, 1995) later used the instrument to assess teachers' environmental literacy.

Todt (1995) studied a group of 46 teachers from southern Ohio. The results were compared with the 37 Ohio teachers from a pilot group, as well as the 11th-graders in Wisconsin for which the survey was originally designed. All groups showed the highest scores on the affective subscale designed to measure positive environmental attitudes. Second-highest scores were achieved for the environmental knowledge category, followed with the lowest score in the reported environmentally appropriate behavior. The teachers scored higher than the 11th-grade students on all subscales.

Owens (2000) studied 292 urban middle-school teachers from a southern United States public school district. The results of this study were compared to the results of the

original 11th-grade students from Wisconsin and the teachers from Todt's (1995) study. The same patterns were observed: The teachers scored higher than the eleventh graders: the affective subscale score was the highest, and reported environmentally appropriate behaviors was the lowest subscale.

Todt (1995) and Owens (2000) gave differing results for the correlation between the number of years teaching and environmental literacy. Todt (1995) found these two variables not to be significantly correlated, while Owens (2000) found the variables to be significantly correlated. This difference in findings could be a result of the differences in sample sizes, with the former study having 46 participants and the latter having 292 participants. Age was a significant factor related to environmental literacy in Todt's (1995) study. Racial-ethnic background and subject-area taught both were found to correlate significantly to environmental literacy in Owen's (2000) study.

Seventh-day Adventist Educational System and Beliefs

The Seventh-day Adventist church has the second largest parochial school system in the world (Wittberg, 2006). The first denominationally sponsored SDA church school started in Battle Creek, Michigan, in 1872. The first school operated by the church outside of North America opened in 1883 in Denmark. By the early 1900s, many schools had been started all over the world (Greenleaf, 2005). The Adventist educational system continued to expand. In 2011, there were 7,804 SDA schools with over 1.67 million students in over 100 countries (General Conference of Seventh-day Adventists, 2011).

According to Seventh-day Adventist denominational records, "The church conducts its own schools, elementary through university, for the purpose of transmitting to its children its own ideals, beliefs, attitudes, values, habits, and customs" (General

Conference of Seventh-day Adventists, 2005, p. 117). The *Southern Union Education Code, PreK-12* (2009) stated:

> The Seventh-day Adventist Church recognizes God as the ultimate source of existence and truth. In the beginning God created in His image, a perfect humanity, a perfection later marred by sin. Through the guidance of the Holy Spirit, God's character and purposes can be understood as revealed in nature, the Bible, and Jesus Christ. The distinctive characteristics of Adventist education, derived from the Bible and the inspired writings of Ellen G. White, point to the redemptive aim of true education: to restore human beings into the image of their maker. . . . Adventist education seeks to develop a life of faith in God and respect for the dignity of all human beings; to build character akin to that of the Creator; to nurture thinkers rather than mere reflectors of others' thoughts; to promote loving service rather than selfish ambition; to ensure maximum development of each individual's potential; and to embrace all this is true, good, and beautiful. . . . It fosters a balanced development of the whole person—physically, intellectually, socially, and spiritually. Working together, homes, schools, and churches cooperate together with divine agencies in preparing learners for responsible citizenship in this world and in the world to come. (p. 4)

The denomination's name, Seventh-day Adventist, represents two fundamental beliefs that drive its mission, values, and behaviors. "Seventh-day" references the church's belief that the seventh day, Saturday, is the Sabbath instituted by a personal Creator God at the end of a literal seven-day week of creating the whole world.

> The beneficent Creator, after the six days of Creation, rested on the seventh day and instituted the Sabbath for all people as a memorial of Creation. The fourth commandment of God's unchangeable law required observance of this seventh-day Sabbath as the day of rest, worship, and ministry in harmony with the teaching and practice of Jesus, the Lord of the Sabbath. The Sabbath is a day of delightful communion with God and one another. It is a symbol of our redemption in Christ, a sign of our sanctification, a token of our allegiance, and a foretatste of our eternal future in God's Kingdom. (General Conference of Seventh-day Adventists, 1988, p. 248)

"Adventist" references the church's belief in the Second "Advent" of Jesus, his literal second coming to this earth. "The second coming of Christ is the blessed hope of the church, the grand climax of the gospel. The Savior's coming will be literal, personal, visible, and worldwide" (General Conference of Seventh-day Adventists, 1988, p. 332).

The Seventh-day Adventist Church has 28 fundamental beliefs. One of these is stewardship. Under "stewardship," the church addresses how this relates to the planet we live on.

> Modern science has made earth one vast laboratory for research and experimentation. Such research yields many benefits, but the industrial revolution has also resulted in air, water, and land pollution. Technology, in some instances, has manipulated nature rather than managing it wisely.
>
> We are stewards of this world, and should do everything to maintain life on all levels by keeping the ecological balance intact. In His coming advent, Christ will "destroy those who destroy the earth" (Rev. 11:18). From this perspective Christian stewards are responsible not only for their own possessions but for the world around them. (General Conference of Seventh-day Adventists, 1988, p. 274)

Religion and Environmental Attitudes

Lynn White (1967) famously argues that Judeo-Christian doctrines are anti-environment, because of the prominence of the separation of man from nature—the idea that nature is there to meet humanity's needs. White puts forth the idea that individuals' views and the way they interact with the environment are anchored in a religious system of belief, and that the Judeo-Christian ethic gives humans the right to do as they see fit with the environment.

While White did not directly study the relationship between religion and environmental concern, later studies have shown some support for White's assertions. Hand and Van Liere (1984), while sampling residents of the state of Washington, examined the link between mastery-over-nature orientation, religious identification and commitment, and concern for environmental problems. Their findings were that non-Judeo-Christians were slightly more likely to show concern for the environment, but that among Judeo-Christian denominations, there was considerable variation in the relationship to the mastery-over-nature orientation. Hand and Van Liere suggested that

the denominations that were viewed as being more "conservative" (Baptists and Mormons) were more likely to emphasize the dominance-of-nature doctrine as compared to the more "liberal" (Episcopalians and Methodists) denominations. Hand and Van Liere felt the "liberal" denominations might in fact be oriented to a stewardship ethic.

Other authors have attempted to provide support for White's thesis. Worster (1994) suggests that the pastorialistic tendencies of Christianity lead only to one conclusion—that mankind is dominant over all other creation. The exclusion of all but humanity from divine grace and the anthropocentric values of the religion has separated man from nature. Nature is seen as a means to support man's desires. Eckberg and Blocker (1996) presented that their research showed support for Christian theology being "anti-environmental," but largely an effect of fundamentalism or sectarianism and did not support a "stewardship" theme. Guth, Kellstedt, and Smidt (1995) reported those outside of the Judeo-Christian tradition to be the most pro-environment, but they did find variation in environmentalism among different religious traditions.

Clifford (1994) presents a concept that has appeared more recently in print (though it has been held in certain orthodox Christian beliefs for an extended time) and that is anti-environment. Some Christians have been using eschatological arguments that if God is going to destroy the present world to make way for a new earth, why should there be concern for the present environment.

Opposed to this, there has been research that seems to negate the basic premise of White's thesis and instead suggests that religion may cause a pro-environmental stewardship effect (Eckberg & Blocker, 1996; Kanagy & Nelson, 1995; Kanagy & Willits, 1993; Kearns, 1997; Shaiko, 1987; Shibley & Wiggins, 1997; Wolkomir, Futreal,

Woodrum, & Hoban, 1997**)**. Much of this has to do with a belief that there is a principle of stewardship of creation implied in the opening book of Genesis (Barkey, 2000; Harrison, 1999; Irwin & Pellegrino, 1994). These conflicting results could be a result of using different measures of both religiosity and environmental orientations and behaviors. Some have suggested that early studies were hindered in that they incorporated only a few questions assessing pro-environmentalism, which did not measure adequately pro-evironmental attitudes or behavior (e.g., Greeley, 1993; Hayes & Marangudakis, 2001). This concern of methodology is important because of the research, which found that the relationship between Christian beliefs and environmentalism is dependent on the way in which environmentalism is measured (Klineberg, McKeever, & Rothenbach, 1998). Some authors suggest that many researchers ignore the complex interrelationships between religious and political factors, which cause environmental concern and activism (Greeley, 1993; Wolkomir et al., 1997).

In research not focused on specific denominations, Kanagy and Nelsen (1995) used data from a national sample to study the relationship between three measures of religiosity and three attitudes about the environment. They found that when religiosity alone was studied, religious respondents were less likely than nonreligious respondents to support additional federal funding to protect the environment, but when age, gender, and region of the county were controlled for, these effects were much less significant. Their argument was that it was not accurate to suggest that those in Judeo-Christian traditions are less concerned about the environment than those from other traditions.

Hayes and Marangudakis (2001) reported they found no significant difference between Christians and non-Christians in environmental attitudes, although they did find

that among Christian denominations, Roman Catholics are the most skeptical toward nature. These authors concluded that the two most notable and consistent factors in determining pro-dominion attitudes were educational attainment and particularly levels of scientific knowledge about the environment.

Some authors have also examined the relationships between religious affiliation and environmental attitudes by conducting analyses across several religious groups at once, as opposed to focusing on a specific religious culture (Boyd, 1999; Eckberg & Blocker, 1996; Kanagy & Nelsen, 1995; Kearns, 1996; Schultz, Zelenzy, & Dalrymple, 2000). In a number of these studies, differences in environmental concern were linked with specific religious denominations and traditions (Boyd, 1999; Hand & Van Liere, 1984). None of these studies looked at Seventh-day Adventists as a group. My study focused specifically on the views of Seventh-day Adventists.

There has been very little research done about Seventh-day Adventists' views about the environment or their environmental literacy. This study starts to explore these views by gathering information from a group of teachers in one of the church's geographic regions (called conferences).

CHAPTER THREE

METHODS

Introduction

The purpose of this study was to assess the environmental literacy of a sample group of SDA teachers for the Florida Conference of Seventh-day Adventists, to determine what the level of environmental literacy is, and to discover the interpretations that these educators have of Gen 1:28. The study specifically looked at four dimensions of these teachers' environmental literacy: (a) teachers' attitudes toward the environment, (b) teachers' feeling toward their roles in causing environmental change, (c) teachers' interactions with their environment, and (d) teachers' level of knowledge about the environment and issues involved. The teachers' interpretations of Gen 1:28 were also be studied.

This chapter contains a description of the quantitative methodology with a qualitative component and procedures used in this study, including research design, population, instrumentation, data collection procedures, and data analysis.

Research Design

The survey instrument (modified WELS) was adapted and administered to all 186 teachers employed by the Florida Conference of Seventh-day Adventists. This census survey technique was used because the population is small enough to accommodate the

technique and allows for input from the entire population of teachers in the Florida Conference.

Population

The population studied was the teachers employed by the Florida Conference of Seventh-day Adventists. The questionnaire, containing the WELS, questions about interpretation of Gen 1:28, and a demographic survey were administered to all the teachers of the conference. The territory of the Florida Conference of Seventh-day Adventists includes the entire state of Florida except the western-panhandle counties (Bay, Calhoun, Escambia, Gulf, Holmes, Jackson, Okaloosa, Santa Rosa, Walton, and Washington counties).

Instrumentation

The study used an adapted version of the Wisconsin Environmental Literacy Survey (WELS) (WCEE, 1994), originally produced to assess the environmental literacy of Wisconsin 11th-grade students. The adaptations were the inclusion of the questions related to Gen 1:28 and changes to the demographic portion of the WELS. The racial/ethnic background categories were based upon the categories used by the U.S. Department of Education in its study, *Characteristics of Private Schools in the United States: Results from the 2005-2006 Private School Universe Survey* (Broughman, Swaim, & Keaton, 2008). During the original production of the instrument, it was vetted using statistical analysis and pilot testing to produce high reliability and validity (Peri, 1996). Both Todt (1995) and Owens (2000) demonstrated the instrument's validity and reliability in each of their studies of teachers' environmental literacy as shown in Table 1.

Table 1

Reliability for Various Administrations of the Environmental Literacy Survey

Group	Affective	Behavioral	Cognitive	Environmental Literacy
Ohio Teachers[a]	.86	.91	.75	.88
Urban Teachers[b]	.90	.88	.88	.90

Note. Reliability reported as Cronbach's alpha
[a] Todt (1995). [b] Owens (2000).

The survey, which was used with permission of the Wisconsin Center for Environmental Education, was made up of the following parts:

Part I of the survey measured the affective learning outcomes (teachers' attitudes toward the environment and their feeling toward their role in causing environmental change). These outcomes were measured at the nominal level of environmental literacy. This section consisted of 30 statements that the teacher responded to using a 5-point Likert-type scale (*strongly agree* to *strongly disagree*). The least environmentally friendly environmental attitude response was assigned a zero, and the most environmentally friendly response was assigned a 4. The lowest possible total score on this section was zero and the highest possible score was 120. Some of the statements were worded so that the most environmentally friendly response was sometimes at one end of the scale and at other times at the other end of the scale. Because of this fact, some of the statements were reverse scored.

Part II of the survey assessed self-reported environmental behaviors and perspectives on those behaviors (teachers' interactions with the environment) and were measured at the functional level of environmental literacy. This section consisted of 16

statements that the teacher responded to using a 5-point Likert-type scale based on frequency of taking action (*almost always* to *never*). A response indicating no behavioral response was assigned a zero, and a response showing greatest behavioral response was assigned a 4. The lowest possible total score on this section was zero and the highest possible score was 64. Some of the statements were worded so that the most environmentally friendly behavior was sometimes at one end of the scale and at other times at the other end of the scale. Because of this fact, some of the statements were reverse scored.

Part III of the survey measured cognitive learning outcomes (teachers' level of knowledge about the environment and issues involved), and the outcomes were measured at the structural/operational level of environmental literacy. This section consisted of 39 multiple-choice questions that measured the teacher's knowledge of basic ecological concepts, environmental problems, and action strategies. Correct responses were assigned a score of 4 and incorrect responses were assigned a score of zero. The lowest possible total score on this section was zero and the highest possible score was 156.

Part IV addressed the issue of respondent demographics. These items included their (a) gender, (b) racial/ethnic backgrounds, (c) age, (d) number of years teaching, (e) college major, (f) area of specialty, and (g) self-evaluation of environmental literacy.

Part V of the survey (not a part of the WELS) attempted to determine the participants' interpretations of Gen 1:28. This section was composed of three open-ended questions to which the teacher could write his/her response. The responses were then analyzed for pattern of responses.

Since each of the first three parts had different numbers of statements, subscale scores were calculated as a mean of all statements in that section. An overall environmental literacy score was calculated by finding the mean score of the three subscale scores. The procedure for scoring the survey was designed so that the higher the numerical mean for each subscale, the higher the estimated level of environmental literacy.

Procedure

I assembled packets that contained the survey, an answer sheet, and a cover letter explaining the purpose of the survey. Each copy of the survey and answer sheet was numbered, which was the only method of identification to guarantee anonymity of the participants. In the cover letter, the participants were given instructions to return the documents to me in the self-addressed envelope provided. I then delivered the packets to the Education Department of the Florida Conference of SDAs to be distributed. Before distribution, the Education Department of the Florida Conference of SDAs assigned a name to each number. This allowed me to track which surveys had not been returned. These name-number combinations were held by the department, so I never knew which participant's answer sheet was being scored. For surveys not returned, I assembled new packets with corresponding numbering and delivered them to the education department, so that another packet could be delivered to those participants to be completed and returned.

The initial surveys were distributed to the participants during the month of April 2009. This was toward the end of a school year. I believed the teachers would be more likely to complete and return the survey during the school year rather than during the

teachers' summer break. As surveys were received in the mail, the corresponding numbers were recorded on a master list.

A follow-up round of surveys was distributed September 2009 to those who had not returned the initial survey. This was done to try to improve response rate. Only teachers who were employed during the initial survey period where sent surveys. This was done to make sure the original population was surveyed.

Data Analysis

Data were analyzed using PASW® Statistics (Field, 2005). Analysis included descriptive statistics of the results, correlational analysis to determine relationships between the variables, analysis of variance (ANOVA) to determine significance of relationships between the variables, and the PASW® general linear model (GLM), which includes ANOVA and regression, to test for interaction effects between demographic variables. Due to the length of time that has passed and geographic locations of studies, the results were not compared to the Ohio teachers studied by the Todt (1995) study or the southern urban teachers from the Owens (2000) study. An item analysis was done to confirm the reliability of the instrument and each of the three subscales.

The open-ended questions about Gen 1:28 were analyzed in terms of the answers to the research questions for emerging similarities among the participants' responses. This was done by coding the data and determining if there are recurring patterns and themes (Marshall & Rossman, 1995). Coding was done by looking for key words or phrases that were repeated. These were then grouped into themes. Words or phrases similar to "have charge," "dominion, "steward," and "manage" were grouped with the theme "responsibility." Words or phrases similar to "preserve," "use wisely," "respect,"

"protect," "sustain," and "not destroying" were grouped in the theme "taking care of the environment." Phrases such as "serve a master" and "serve a need" were grouped in the theme "self-serving use of the earth and its resources." Words or phrases which relayed a message of earth having a purpose were group in the theme "earth as a gift from God." Four individuals, including myself, coded all participants' responses. Each coder's results were compared with those of others to look for agreement or conflicts. The resulting patterns and themes were examined in relationship to answers on the WELS.

When doing qualitative research, personal bias needs to be addressed (Merriam, 2002). My personal bias comes from several areas. First, I am a member of the Seventh-day Adventist church and a teacher in the Florida Conference of Seventh-day Adventists. I have taught science in the parochial education system of the Seventh-day Adventist Church for 19 years in both Maryland and Florida. This experience provided me with some practical understanding of the educational system and church structure as well as Seventh-day Adventist "culture." Second, I have an interest in environmental education, especially since I believe that God put man on the earth to take care of the planet as it is used for human needs. I believe it is important for humanity to understand its place and relationship in the ecological world. It is important that this bias be stated clearly in my report of this study because my close connection with and understanding of the educational process of Seventh-day Adventism and the concepts of environmental education and environmental literacy have the potential to influence the findings and the conclusions drawn.

To guard against this bias affecting the results of this study, I had others code the qualitative research portions along with myself. This allowed for themes to develop

independent of my groupings. And the WELS questions were developed by other researchers, which gave them independence from my bias.

CHAPTER FOUR

RESULTS

This chapter presents the results of the survey according to statistical analyses of the data collected. Findings are presented both in narrative and table formats. The chapter begins with a description of the response rate and general demographic characteristics of the respondents who chose to participate.

Research Questions

The core research questions of this study are:

1. What levels of environmental literacy do participating teachers show as measured by the Wisconsin Environmental Literacy Survey (WELS) based on their (a) gender, (b) racial-ethnic backgrounds, (c) age, (d) number of years teaching, (e) area of specialty, and (f) self-evaluation of environmental literacy?

2. What interactions, if any, are shown between these factors, and how do these factors relate to the subscales used in the WELS?

3. What interpretations of Gen 1:28 do participating teachers have, and do these interpretations have an impact on the way they teach or what they teach?

Description of Population Surveyed

Of the total population of 186 teachers in the parochial schools of the Florida Conference of Seventh-day Adventists, 63 teachers partially completed or totally

completed the research survey. This represents 34% of the teachers invited to participate. Table 2 provides a descriptive summary of the respondents. The majority (*N*=37) responded as being female, as opposed to male (*N*=21) or not responding (*N*=5). The dominant ethnicity responding was White, non-Hispanic (*N*=34); followed by Hispanic (*N*=14); Black, non-Hispanic (*N*=5); and Other (*N*= 3). Seven did not report ethnicity. Age was fairly evenly distributed across responses with the largest grouping being in the 41-50 years of age range. Years teaching showed a similar pattern with the largest grouping being in the 25+ category.

Scale Evaluation

The data on the three subscales (affective, behavioral, and cognitive) were reported as a percentage of the maximum number of points. When missing data were found, PASW® Statistics was instructed to use the number of values present instead of the total number of cases in the sample to calculate a valid percentage.

A total environmental literacy score was calculated by combining the three subscales score, and the EL score was then reported as a percentage. It could be argued that this score has limited meaning, since it consists of results of three subscales that contain different types of items with different types of responses (WCEE, 1994). For example, a 50% score on the behavioral subscale indicates that the respondents, on average, said that they sometimes do environmentally positive behaviors, whereas a 50% score on the affective subscale indicates that the respondents had 'no opinion' about the statement given. A 50% score on the cognitive subscale indicates, on average, that the respondents picked the preferred response for 50% of the items in that subscale.

Table 2

Demographic Characteristics of Respondents[a]

Characteristic	Description	Number	Percentage
Gender	Female	37	63.8
	Male	21	36.2
Ethnicity	Black, non-Hispanic	5	8.9
	Hispanic	14	25.0
	White, non-Hispanic	34	60.7
	Other	3	5.4
Age	<31	6	10.3
	31-40	7	12.1
	41-50	19	32.8
	51-60	15	25.9
	>60	11	19.0
Years of Teaching Experience	1-5	4	6.9
	6-10	8	13.8
	11-15	10	17.2
	16-20	7	12.1
	21-25	8	12.7
	25+	21	36.2
Major	Education	29	50.0
	Humanities	13	22.4
	Mathematics	3	5.2
	Science	8	13.8
	Other	5	8.6

[a]All respondents did not respond to all demographic questions. This could result in variable totals.

Table 3 displays the subscale and environmental literacy scores of Florida Conference parochial school teachers who participated in the study. The respondents scored highest on the cognitive subscale, which measured environmental knowledge. The second highest score was on the affective subscale, which measured environmental attitudes and beliefs. The lowest score for the respondents was on the behavioral subscale, on which the respondents self-reported their positive environmental behaviors and practices.

Table 3

Environmental Literacy Scores for Florida Conference Educators

	Mean	Standard Deviation
Affective	73	12
Behavioral	49	14
Cognitive	76	12
Environmental Literacy[a]	66	9

Note: The values represent the percentage of questions answered with the preferred (affective and behavioral) or preferred best (cognitive) answers.
[a]Environmental Literacy is calculated as the percentage of the maximum number of points.

Reliability statistics for the WELS reported by Todt (1995) and Owens (2000) compared favorably with those calculated for this study. Table 4 contains reliability results to show statistics for Florida Conference teachers in this study. Reliability for this instrument was determined using Cronbach's alpha. Reliability coefficients were within

the acceptable range with .72 (cognitive) being the lowest and .88 (affective) being the highest.

> Cronbach's alpha reliability coefficient normally ranges between 0 and 1. However, there is actually no lower limit to the coefficient. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. . . . George and Mallery (2003) provided the following rule of thumb: "->.9 – Excellent, _> .8 – Good, _> .7 – Acceptable, _> .6 – questionable, _> .5 – Poor, and _< .5 – unacceptable" (pg. 231). . . . It should also be noted that an alpha of .8 is probably a reasonable goal. (Gliem & Gliem, 2003, p. 6)

Table 4

Reliability for Various Administrations of the Environmental Literacy Survey

Group	Affective	Behavioral	Cognitive	Environmental Literacy
Ohio Teachers[a]	.86	.91	.75	.88
Urban Teachers[b]	.90	.88	.88	.90
Florida SDA Teachers	.88	.87	.72	.79

[a] Todt (1995). [b] Owens (2000).

A correlational analysis was performed using PASW® Statistics to attempt to identify relationships between demographic characteristics and the WELS subscales. Table 5 shows correlation coefficients and the levels of significance. Gender is correlated with college major ($p < .05$). The correlation between respondent's age and number of years teaching is consistent with logical expectations ($p < .01$). The respondents' perceived environmental literacy and actual surveyed environmental literacy score was significantly correlated with total score ($p < .01$), affective subscale ($p < .01$), behavioral subscale ($p < .01$), and cognitive subscale ($p < .01$).

Table 5

Correlation Coefficients of Environmental Literacy Survey and Demographic Characteristics

	GENDER	ETHNIC	AGE	TEACH	MAJOR	ENVLIT	AFFEC	BEHAVE	COGN	ELPERC
GENDER	1.000									
ETHNIC	.249	1.000								
AGE	.252	.035	1.000							
TEACH	.225	.076	.759**	1.000						
MAJOR	.267*	-.054	-.131	-.082	1.000					
ENVLIT	.167	.123	-.061	-.181	-.062	1.000				
AFFEC	-.083	-.101	-.074	-.044	-.096	.365**	1.000			
BEHAVE	.102	.087	.054	.159	-.106	.536**	.510**	1.000		
COGN	.127	.219	.125	.095	.009	.351**	-.136	.225	1.000	
ELPERC	.055	.089	.063	.110	-.108	.597**	.670**	.869**	.510**	1.00

Note. GENDER = Gender ETHNIC = Ethnicity
AGE = Age TEACH = Numbers of years teaching
MAJOR = Major in college ENVLIT = Reported environmental literacy
AFFECT = Percentage of preferred responses on Attitude Subscale
BEHAVE = Percentage of preferred responses on Behavioral Subscale
COGN = Percentage of preferred responses on Cognitive Subscale
ELPERC = Percentage of total number of possible points on *Environmental Literacy Survey*

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

The correlations between the environmental literacy score and the individual subscales are in harmony with the high survey reliability. The affective subscale is positively correlated with the behavioral subscale ($p < .01$) and overall environmental literacy score ($p < .01$). The behavioral subscale is positively correlated with the affective subscale ($p < .01$) and overall environmental literacy score ($p < .01$). The cognitive subscale is correlated to the overall environmental literacy score ($p < .01$). Overall environmental literacy score is correlated to all three subscales ($p < .01$).

Analysis of Variance

The first question of the study was designed to ascertain how respondents varied in their environmental literacy as measured by the WELS based on their (a) gender, (b) ethnicity, (c) age, (d) years teaching, and (e) perceived environmental literacy. To produce data for this question, an analysis of variance (ANOVA) was performed on each of the five sets of demographic variables and the principle measure of environmental literacy, including the three subscales and environmental literacy score. Cases with missing values were excluded on an analysis-by-analysis basis. Post hoc comparisons of means were conducted on variables with more than two groups to evaluate pairwise differences among the means using the Dunnett's *C* test. Statistically significant ($p < .05$) results were found between the demographic variables ethnicity and self-estimation of environmental literacy.

Gender

Table 6 shows that women scored higher on the affective subscale, but the difference was not statistically significant. Men scored higher than women on the

Table 6

Analysis of Variance Results Comparing Responses by Gender

Variable	Female *M*	Male *M*	All *M*	*F*	*p*
Affective	73.42 *N*=37	71.39 *N*=21	72.69 *N*=58	.389	.536
Behavioral	46.45 *N*=37	49.18 *N*=21	47.44 *N*=58	.584	.448
Cognitive	74.59 *N*=34	77.66 *N*=21	75.76 *N*=55	.863	.357
Environmental Literacy[a]	65.11 *N*=34	66.08 *N*=21	65.48 *N*=55	.158	.693

Note. The values represent the percentage of questions answered with the preferred (affective and behavioral) or preferred best (cognitive) answers.

[a]Environmental Literacy is calculated as the percentage of the maximum number of points.

behavioral and the cognitive subscales, and the total environmental literacy, but these differences were not significantly different.

Ethnicity

Table 7 shows statistically significant differences in the cognitive subscale between the groups, F (3,49) = 5.09, p = .004. Follow-up tests were conducted to evaluate pairwise differences among the means. Because the variances among the groups ranged from 74.01 to 199.4, I chose not to assume the variances were homogeneous and conducted post hoc comparisons with the use of the Dunnett's C test, which does not assume equal variances among the groups. White, non-Hispanics scored significantly higher than did Hispanics on the cognitive subscale.

Age

Table 8 displays the results of the ANOVA testing based on age groupings. Although the age grouping, less than 31 years of age, had the highest average score on the affective subscale, it was not statistically significant. Table 8 shows there was no statistically significant difference in scores from each of the subscales or total environmental literacy between the five age groupings.

Years of Teaching

Table 9 displays the results of the ANOVA testing based on years of teaching. Table 9 shows there was no statistical significant difference in scores from each of the subscales or total environmental literacy between the five years-of-teaching groupings.

Table 7

Analysis of Variance Results Comparing Responses by Ethnicity

Variable	Black, Non-Hispanic	Hispanic	White, Non-Hispanic	Other	*F*	*p*
	M	*M*	*M*	*M*		
Affective	74.17 *N*=5	74.35 *N*=14	72.89 *N*=34	66.94 *N*=3	.327	.806
Behavioral	47.81 *N*=5	44.20 *N*=14	50.97 *N*=34	40.63 *N*=3	1.54	.214
Cognitive	78.85 *N*=4	65.68*[b] *N*=13	79.33*[b] *N*=33	73.50 *N*=3	5.086	.004
Environmental Literacy[a]	67.05 *N*=4	61.81 *N*=13	67.91 *N*=33	60.36 *N*=3	2.20	.099

Note. The values represent the percentage of questions answered with the preferred (affective and behavioral) or preferred best (cognitive) answers.

[a]Environmental Literacy is calculated as the percentage of the maximum number of points.

[b]White, non-Hispanics scored significantly higher than Hispanics.
* $p < .01$

Table 8

Analysis of Variance Results Comparing Responses by Age

Variable	< 31	31 – 40	41 – 50	51 – 60	> 60	*F*	*p*
	M	*M*	*M*	*M*	*M*		
Affective	80.42	70.24	71.27	71.39	74.24	.860	.494
	N=6	*N*=7	*N*=19	*N*=15	*N*=11		
Behavioral	50.00	44.20	46.55	46.56	50.71	.348	.844
	N=6	*N*=7	*N*=19	*N*=15	*N*= 11		
Cognitive	71.79	76.19	75.71	74.79	75.79	.350	.843
	N=6	*N*= 7	*N*=19	*N*=12	*N*=11		
Environmental Literacy[a]	67.40	63.62	64.51	64.91	67.91	.426	.789
	N=6	*N*=7	*N*= 19	*N*=12	*N*=11		

Note. The values represent the percentage of questions answered with the preferred (affective and behavioral) or preferred best (cognitive) answers.

[a]Environmental Literacy is calculated as the percentage of the maximum number of points.

Table 9

Analysis of Variance Results Comparing Responses by Years of Teaching

Variable	1 – 5	6 - 10	11 – 15	16 – 20	21 – 25	25+	*F*	*p*
	M	*M*	*M*	*M*	*M*	M		
Affective	83.75	67.71	70.08	77.14	73.33	71.98	1.324	.269
	N=4	*N*=8	*N*=10	*N*=7	*N*=8	*N*=21		
Behavioral	50.78	42.97	41.25	48.66	52.75	49.03	1.035	.407
	N=4	*N*= 8	*N*=10	*N*=7	*N*=8	*N*=21		
Cognitive	71.79	75.00	75.64	74.87	76.92	76.68	.128	.985
	N=4	*N*=8	*N*=10	*N*=5	*N*=7	*N*=21		
Environmental Literacy[a]	68.78	61.89	62.32	68.53	68.77	65.90	.992	.432
	N=4	*N*=8	*N*=10	*N*=5	*N*=7	*N*=21		

Note. The values represent the percentage of questions answered with the preferred (affective and behavioral) or preferred best (cognitive) answers.

[a]Environmental Literacy is calculated as the percentage of the maximum number of points.

Major

Table 10 displays the results of the ANOVA testing based on major in college. Table 10 shows there were no statistically significant differences in scores from each of the subscales or from total environmental literacy for the five groups of majors.

Self-Estimation of Environmental Literacy

Table 11 shows statistically significant differences in the affective subscale between the groups, F (2,55) = 4.48, p = .016; behavioral subscale between the groups, F(2,55) = 12.45, p = .000; and on total environmental literacy, F (2,52) = 15.13, p = .000. Also, respondents who self-estimated themselves to have high environmental literacy, scored significantly higher than those who self-estimated themselves to have low environmental literacy on the cognitive subscale, F (2,52) = 4.20, p = .020. Follow-up tests were conducted to evaluate pairwise differences among the means. Because the variances among the groups ranged greatly, I chose not to assume the variances were homogeneous and conducted post hoc comparisons with the use of the Dunnett's C test, which does not assume equal variances among the groups.

Frequently Missed Questions

The cognitive (knowledge) subscale, being the only subscale that had correct answers instead of preferred answers, was used to ascertain whether there were patterns of missed questions. Table 12 displays that 40% or more of the teachers from Florida Conference missed six items on the cognitive subscale, and 50% or more of the teachers missed only three items (see Appendix A for the full text and format of the WELS questions).

Table 10

Analysis of Variance Results Comparing Responses by Major

Variable	Education	Humanities	Mathematics	Science	Others	*F*	*p*
	M	*M*	*M*	*M*	*M*		
Affective	72.30	76.28	80.83	65.94	71.50	1.348	.264
	N=29	*N*=13	*N*=3	*N*=8	*N*=5		
Behavioral	47.04	51.44	49.48	45.90	40.63	.687	.604
	N=29	*N*=13	*N*=3	*N*=8	*N*=5		
Cognitive	74.64	80.77	61.54	77.88	74.87	1.843	.135
	N=27	*N*=12	*N*=3	*N*=8	*N*=5		
Environmental Literacy[a]	64.85	70.09	63.95	63.24	62.33	1.231	.309
	N=27	*N*=12	*N*=3	*N*=8	*N*=5		

Note. The values represent the percentage of questions answered with the preferred (affective and behavioral) or preferred best (cognitive) answers.

[a]Environmental Literacy is calculated as the percentage of the maximum number of points.

Table 11

Analysis of Variance Results Comparing Responses by Self-Estimation of Environmental Literacy

Variable	Low *M*	Moderate *M*	High *M*	*F*	*p*
Affective	66.35* *N*=8	69.97* *N*=26	77.74*[b] *N*=24	4.48	.016
Behavioral	31.25*[c] *N*=8	46.75* *N*=26	53.58* N=24	12.45	.000
Cognitive	65.20*[d] *N*=7	75.43 *N*=24	79.17*[d] *N*=24	4.20	.020
Environmental Literacy[a]	54.02* *N*=7	64.14* *N*=24	70.16* *N*=24	15.13	.000

Note. The values represent the percentage of questions answered with the preferred (affective and behavioral) or preferred best (cognitive) answers.

[a]Environmental Literacy is calculated as the percentage of the maximum number of points.

[b]Those self-estimating themselves with high environmental literacy scored higher than those self-estimating themselves with moderate or low environmental literacy. The difference between those self-estimating themselves with moderate environmental literacy and low environmental literacy was not significant.

[c]Those self-estimating themselves with low environmental literacy scored lower than those self-estimating themselves with moderate or high environmental literacy. The difference between those self-estimating themselves with moderate environmental literacy and high environmental literacy was not significant.

[d]Those who self-estimated themselves with high environmental literacy scored significantly higher than those who self-estimated themselves with low environmental literacy.

Table 12

Questions From Cognitive Subscale Missed by 40% or More of the Florida Conference Teachers

Question Number	Question Subject	Percentage Missed
47	Food Web	40
53	2nd Law of Energy	44
58	Biomagnification	52
67	Human Population Dynamics	52
73	Water Pollutants	46
83	Solid Waste Reduction	61

The six questions missed by at least 40% of respondents were looked at in more detail. Two out of seven *knowledge of ecological principles*, involving individuals, populations, and communities, were missed by 40% or more teachers. Question 47, which was answered incorrectly by 40% of the teachers, involved knowing what a food web was. Question 58, answered incorrectly by 52% of the teachers, tested for knowledge of the concept of biomagnification, which involves the process of contamination in body fat of animals increasing as it is passed up the food chain.

Another subcategory of *knowledge of ecological principles* concerned energy flow. Forty percent of the teachers missed one of four questions in that area. Question 53, answered incorrectly by 44% of the teachers, concerned an understanding of the concept of the second law of the conservation of energy, which is that energy cannot be created or destroyed, but only changes forms.

Forty percent or more of the teachers missed one of three questions in the category of *knowledge of environmental problems and issues* pertaining to water quality and quantity. Question 73, answered incorrectly by 46% of the teachers, required the teacher to be able to identify bacteria, pesticides, and heat as being major water pollutants.

Another subcategory of *knowledge of environmental problems and issues* concerned dynamics of human population growth. Forty percent of teachers missed one of two questions in this area. Question 67, answered incorrectly by 52% of the teachers, involved knowledge of population growth patterns and their impact on organisms.

Forty percent or more of the teachers missed one of five questions in the category of *knowledge of environmental issue investigation and action strategies*. Question 83

(most-missed question in the cognitive subscale), answered incorrectly by 61% of teachers, required the teacher to be able to identify waste reduction as the best way to lessen the problem of solid waste.

Environmental Sensitivity and Attitudes Toward Environment

The affective subscale contained statements involving the teachers' environmental sensitivity/awareness. Along with this, there were statements related to attitudes and values for the prevention and remediation of environmental problems and issues and responsibility to effect change. Responses to all 30 statements were analyzed, and four statements had responses that were negative toward the environment by at least 25% of respondents.

WELS Question 13. Question 13 stated, "I believe that plants and animals exist to be used by humans." More than 25% of teachers responded they strongly agreed (5%) or agreed (25%). Twenty-two percent had no opinion, and less than 50% disagreed (27%) or strongly disagreed (21%).

WELS Question 17. Question 17 stated, "Environmental restrictions should be lifted so that exploration and production of fossil fuels can be increased." More than 25% of teachers responded they strongly agreed (8%) or agreed (19%). Nineteen percent had no opinion, and more than 50% disagreed (33%) or strongly disagreed (21%).

WELS Question 18. Question 18 stated, "If a person's car exceeds certain standards for air pollution, he or she should not be allowed to drive it." More than 25% of teachers responded they strongly disagreed (6%) or disagreed (21%). Twenty-one percent had no opinion and more than 50% agreed (33%) or strongly agreed (19%).

WELS Question 21. Question 21 stated, "Laws should be passed and enforced that protect the quality of life in the future even if it means that individual freedoms are limited." More than 25% of teachers responded they strongly agreed (10%) or agreed (18%). Twenty-five percent had no opinion, and less than 50% disagreed (38%) or strongly disagreed (10%).

Environmentally Responsible Behavior and Actions

The behavioral subscale, containing 17 statements, contained statements involving the teachers' environmentally responsible behaviors and actions. Responses to all 17 statements were analyzed, and four statements had responses that were negative toward the environment by at least 50% of respondents.

WELS Question 34. Question 34 stated, "I walk, take public transportation, or ride a bike instead of using a car in order to help protect the environment." More than 50% of teachers responded they "never" (29%) or "almost never" (46%). Sixteen percent responded "sometimes" and less than 10% "often" (6%) or "almost always" (3%).

WELS Question 42. Question 42 stated, "I write or call politicians to express my views about environmental issues." More than 75% of teachers responded "never" (56%) or "almost never" (25%). Eighteen percent responded "sometimes" and only 2% "often."

WELS Question 45. Question 45 stated, "I send letters to the newspaper about environmental problems or issues." More than 85% of teachers responded "never" (56%) or "almost never" (32%). Ten percent responded "sometimes" and only 3% responded "often."

WELS Question 46. Question 46 stated, "I have reported environmental problems or violations that I have noticed to the proper authorities." More than 80% of

teachers responded “never” (49%) or “almost never” (32%). Thirteen percent responded “sometimes” and less than 10% percent “often” (2%) or “almost always” (5%).

Open-ended Question Responses

Not all respondents gave answers to the open-ended questions. Many themes were gleaned from the responses to the three open-ended questions from the survey. These were combined to conclude with four main themes. Two of the themes displayed in the majority of respondents were “responsibility” (31 of 45 respondents) and “taking care of the environment” (34 of 45 respondents). The two other less-displayed themes were “earth as a gift from God” (5 of 45 respondents) and “self-serving use of the earth and its resources” (4 of 45 respondents). The four themes will be described in the words of the respondents in the following sections.

The two main themes, responsibility and taking care of the environment, were tightly connected. The “responsibility” theme dealt with an affective component, while the “taking care of the environment” theme related to a behavioral component. Many times both of them were given in the same response.

Responsibility

In the analysis of the response to the three open-ended questions, the concept of responsibility was found in a majority of the responses (69%). Although often referenced with the exact terminology of “responsibility,” other times this concept was referenced as “authority,” “have charge,” “dominion,” “steward,” or “manage.”

One respondent stated, “Ruling over something implies responsibility for, not have permission or right to exploit or destroy.” Other respondents gave answers like: “We are to oversee and take care of all living creatures that live on this earth. Make sure

we are not destroying their habitats and environments, we are responsible for this." and "I teach my students to be good stewards but to be skeptical of those who would use the environment and manipulate and control." Some respondents went further. An example of this is:

> God gave us responsibility to rule. A good ruler cares for his subjects. In fact, he/she is accountable to God for each thing under his rule. As a ruler, we need to know what each entity needs to survive and live healthily and happy. It is our responsibility to take care of any problems that come up. If we need help beyond our knowledge and ability, God always stands ready to help.

Other approaches to the theme included: "It is God's plan for us to procreate (have children). We also have the responsibility to be His stewards: we must manage the Earth and all its resources. Our practices and lifestyle must ensure and sustain a well-balanced ecological system."

Taking Care of the Environment

This theme was tightly connected to the previous one and was found in the majority of responses (76%) also. This theme was related more to being behavioral in nature. Although often referenced with the exact terminology of "taking care," other times this concept was referenced as "preserve," "use wisely," "respect," "sustain," or "not destroy (plunder)."

One participant displayed this theme with the response, "My interpretation is that God said we would rule all that he created— <u>not destroy it</u>. We should take care and preserve what God has given to us. I am sure God is upset with humans as they slowly are destroying all his pure beauty." Other similar responses were, "God gave man control over the earth but expected us to be responsible to maintain and protect it. We are caretakers and should live in harmony with it, not destroy or plunder it," and "We are to

oversee and take care of all living creatures that live on this earth. Make sure we are not destroying their habitats and environments, we are responsible for this."

As was mentioned earlier, the two main themes, responsibility and taking care of the environment, many times were connected. Two responses demonstrated this well: "Humans and animals are not on the same level. Mankind has been given dominion by God over the other living creatures that he has made. However, as with any position of authority, we are held responsible for how we treat and care for them," and "Humans are to be stewards of the earth—caring for and fostering its health and well-being. God did create the earth for us, but not so we could take advantage of it. Instead, we should preserve and respect it as we would with any place in which we live."

Earth as a Gift from God

A minor theme that was discovered was one related to the earth being a gift to humans. In this theme, there is a thought of earth having a purpose. One participant wrote the following:

> God created earth for man. In order for earth to fulfill its purpose, man was to care for and nurture it. As man grew in understanding and numbers, all creation was to benefit. Considering love was the underlying rule when this verse was said, harmony would have resulted and been demonstrated through experience with growth.

Two other quotes are, "God gave us the privilege of take care of nature. If we destroy nature, we are destroying our selves," and "Take the earth as a gift. Use it to live well and feed your family. Rule over the earth. A ruler should be responsible for its minions' well-being. . . . If we are to rule over every living creature . . . we should rule responsibly."

Self-serving Use of the Earth and Its Environment

The final theme that was discovered was one that was counter to the other three. It focused on the earth being here to supply human needs. Some responses were very human-centered. Two such were "In order to rule, a person is to take care of those ruled because those ruled are to serve their master. If the ruled die, the rulers will die," and "God created the earth and all its living and nonliving resources for humans to use to improve human life."

Other responses included, "The earth is ours to use and care for in a responsible way to met our needs," and "Care for the earth and help it continue to thrive. For as the earth thrives, so do people. God gave gift of creation and maintaining (not destroying) creation."

CHAPTER FIVE

SUMMARY, DISCUSSION, AND RECOMMENDATIONS FOR FURTHER STUDY

This chapter provides a summary of the study including a statement of the problem and the purpose of the study, an overview of relevant literature, and a review of methodology used. This is followed by a summary and discussion of results from Chapter 4. The chapter finishes with recommendations regarding future research.

Problem in Context

The major issues addressed in this study are determining the environmental literacy of teachers in the Florida Conference of Seventh-day Adventists and their interpretation of Gen 1:28:

> God blessed them and said to them, Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground. (Gen 1:28, NIV)

The limited knowledge of the environment is a problem in the United States (Coyle, 2005). The development of an environmental literate citizenry, which leads to environmentally responsible behavior, is one of the goals of environmental education. Teachers with suitable environmental literacy can widen the impact of environmental education broadly and effectively (UNESCO, 1988). The Seventh-day Adventist Church released a "Statement on Stewardship of the Environment" (General Conference of

Seventh-day Adventists, 1996) in which it advocates "reformation of lifestyle . . . based on respect for nature, restraint in the use of the world's resources, reevaluation of one's needs, and reaffirmation of the dignity of created life" (p. 1). The ideas of respect for nature, restraint in use, evaluation of one's needs, and dignity of life are key components of environmental education. Since the SDA education system serves to educate the youth of the church, it is reasonable to assume that the environmental literacy of the teachers in SDA parochial schools is important to the furthering of the church's environmental beliefs. Successful environmental education is dependent on the classroom teacher (Ramsey et al., 1992), and their environmental literacy could affect their students' development of environmental literacy.

A teacher's interpretation of Gen 1:28 would have a direct bearing on a teacher's environmental literacy. If a teacher has a mastery-over-nature orientation, which suggests that nature is strictly there to meet humanity's needs, this would imply an anti-environment mind-set leading to low environmental literacy. If a teacher has a stewardship orientation, which suggests that nature is there to be used in a sustainable way, this would imply a pro-environment mind-set leading to higher environmental literacy. Debate is ongoing about which mind-set is the prevailing one in Judeo-Christian religions (Eckberg & Blocker, 1996; Hand & Van Liere, 1984; Kanagy & Nelsen, 1995; Kearns, 1997; Truelove & Joireman, 2009; Wolkomir et al., 1997; Worster, 1994).

Purpose of the Study

The purpose of this study was to attempt to assess the environmental literacy of a group of teachers in Seventh-day Adventist (SDA) parochial schools who teach in the schools of the Florida Conference of Seventh-day Adventists, to determine what the level

of environmental literacy is, and to discover the interpretations that these educators have of Gen 1:28. The study specifically looked at four dimensions of these teachers' environmental literacy: (a) teachers' attitudes toward the environment, (b) teachers' feeling toward their roles in causing environmental change, (c) teachers' interactions with their environment, and (d) teachers' level of knowledge about the environment and issues involved. The teachers' interpretations of Gen 1:28 were also studied.

Research Questions

The core research questions of this study are:

1. What levels of environmental literacy do participating teachers show as measured by the Wisconsin Environmental Literacy Survey (WELS) based on their (a) gender, (b) racial-ethnic backgrounds, (c) age, (d) number of years teaching, (e) area of specialty, and (f) self-evaluation of environmental literacy?

2. What interactions, if any, are shown between these factors, and how do these factors relate to the subscales used in the WELS?

3. What interpretations of Gen 1:28 do participating teachers have?

Methodology

This research employed a survey research method. All 186 teachers of the parochial schools of the Florida Conference of Seventh-day Adventists were asked to respond to the survey. A census survey was utilized to conduct a study of the teachers' environmental literacy and their interpretation of Gen 1:28. The territory of the Florida Conference of Seventh-day Adventists includes the entire state of Florida except the

western-panhandle counties (Bay, Calhoun, Escambia, Gulf, Holmes, Jackson, Okaloosa, Santa Rosa, Walton, and Washington counties).

The study used an adapted version of the Wisconsin Environmental Literacy Survey (WELS) (WCEE, 1994), originally produced to assess the environmental literacy of Wisconsin 11th-grade students. Both Todt (1995) and Owens (2000) used the instrument for their studies of teachers' environmental literacy. Todt (1995) studied public school teachers from the state of Ohio, while Owens (2000) studied urban public school teachers from a metropolitan county of the south. The adaptations were the inclusion of the questions related to Gen 1:28 and changes to the demographic portion of the WELS. The survey was made up of the following parts:

Part I of the survey measured the affective learning outcomes (teachers' attitudes toward the environment and their feeling toward their role in causing environmental change). These outcomes were measured at the nominal level of environmental literacy. This section consisted of 30 statements, which the teacher responded to using a 5-point Likert-type scale (*strongly agree* to *strongly disagree*). The least environmentally friendly environmental-attitude response was assigned a zero, and the most environmentally friendly response was assigned a 4. Some of the statements were worded so that the most environmentally friendly response was sometimes at one end of the scale and at other times at the other end of the scale. Because of this fact, some of the statements were reverse scored.

Part II of the survey assessed self-reported environmental behaviors and perspectives on those behaviors (teachers' interactions with the environment) and were measured at the functional level of environmental literacy. This section consisted of 16

statements, which the teacher responded to using a 5-point Likert-type scale based on frequency of taking action (*almost always* to *never*). A response indicating no behavioral response was assigned a zero, and response showing greatest behavioral response was assigned a 4. Some of the statements were worded so that the most environmentally friendly behavior was sometimes at one end of the scale and at other times at the other end of the scale. Because of this fact, some of the statements were reverse scored.

Part III of the survey measured cognitive learning outcomes (teachers' level of knowledge about the environment and issues involved), and the outcomes were measured at the structural/operational level of environmental literacy. This section consisted of 39 multiple-choice questions that measured the teacher's knowledge of basic ecological concepts, environmental problems, and action strategies. Correct responses were assigned a score of 4 and incorrect responses were assigned a score of zero.

Since each of the first three parts had different numbers of statements, subscales scores were calculated as a mean of all statements in that section and converted to a percentage. An overall environmental literacy score was calculated by finding the mean percentage of the three subscale scores. The procedure for scoring the survey was designed so that the higher the numerical mean for each subscale, the higher the estimated level of environmental literacy.

Part IV collected respondent demographics. These items included the participants' (a) gender, (b) racial/ethnic backgrounds, (c) age, (d) number of years teaching, (e) college major, (f) area of specialty, and (g) self-evaluation of environmental literacy.

Part V of the survey attempted to determine the participants' interpretations of Gen 1:28. This section was composed of three open-ended questions to which the teacher could write his/her response. The responses were then analyzed for pattern of responses.

Data analysis included descriptive statistics of the results, correlational analysis to determine relationships between the variables, analysis of variance (ANOVA) to determine significance of relationships between variables, and the PASW® Statistics general linear model (GLM), which includes ANOVA and regression, to test for interaction effects between demographic variables.

The open-ended questions about Gen 1:28 were analyzed in terms of the answers to the research questions for emerging similarities among the participants' responses. Coding was done by looking for key words or phrases that were repeated. These were then grouped into themes. Words or phrases similar to "have charge," "dominion, "steward," and "manage" were grouped with the theme "responsibility." Words or phrases similar to "preserve," "use wisely," "respect," "protect," "sustain," and "not destroying" were grouped in the theme "taking care of the environment." Phrases such as "serve a master" and "serve a need" were grouped in the theme "self-serving use of the earth and its resources." Words or phrases which relayed a message of earth having a purpose were group in the theme "earth as a gift from God." Four individuals, including myself, coded all participants' responses. Each coder's results were compared with those of others to look for agreement or conflicts. The resulting patterns and themes were examined in relationship to answers on the WELS.

Discussion of Findings

The teachers of the parochial schools operated by the Florida Conference of Seventh-day Adventists who participated in the study showed nominal environmental literacy. The mean total environmental literacy score was 66%. The subscale that the participants scored the highest on was the cognitive subscale (76%), followed by the affective subscale (73%) and, lastly, the behavioral subscale (49%). As suggested by the scores, these teachers have room for improvement, like many other populations studied (Buethe & Smallwood, 1986; Champeau, 1997; Nagra, 2010; Owens, 2000; Todt, 1995). This study did not find a relationship between the environmental knowledge that the teacher had and their attitudes and behaviors in regard to the environment. A significant difference in cognitive subscale scores between White, Non-Hispanics, and Hispanics was discovered. The study discovered four themes in teachers' interpretations of Gen 1:28. The themes included: responsibility, take care of the environment, earth as a gift, and self-serving.

Due to the relatively low response rate, there is limited representation. This does not affect the validity of the results, but it does cause the need to be careful to not misrepresent what the outcomes of the study were. A higher response rate might provide a better sample, which might better represent the population being studied. Also, if an instrument could be designed that could be completed in a shorter amount of time, the response rate would probably be higher, giving more confidence in the results.

Relationship Between Cognitive Subscale and Affective and Behavioral Subscales

This study found no correlation between the knowledge component of environmental literacy and those of the affective component or behavioral component.

This is consistent with previous studies of individuals (Chawla, 1998; Hines, Hungerford, & Tomera, 1986/1987; Klomuss & Agyeman, 2002; Marcinkowski, 1989; Sia, Hungerford, & Tomera, 1985/1986; Wilke, 1995, Zelezney, 1999).

Gender

Previous studies (Owens, 2000; Todt, 1995) of teachers using the Wisconsin Environmental Literacy Survey (WELS) did not show significant differences between genders. Both studies did report that males scored higher on the cognitive subscale, but neither was significant. The present study reports that males scored higher than did females on the behavioral and cognitive subscales, and total environmental literacy score, but none of these differences were significant. This could be due to the small sample size. Additional research using larger populations might help in clarifying if there is a significant difference between the scores of males and females.

Ethnicity

Owens (2000) reported that European Americans scored significantly higher than did African Americans on both the cognitive subscale ($p = .000$) and total environmental literacy scores ($p = .004$). Owen's sample was 49% African American, 36% European American, and 15% "Other." This current study reports that White, non-Hispanics scored significantly higher than did Hispanics on the cognitive subscale ($p = .004$). There has been very limited research on Hispanics when it comes to environmental attitudes, knowledge, or behaviors (Whittaker, Segura, & Bowler, 2005). Peterson, Sternberg, Lopez, and Liu (2008) found that Latinos had low wildlife knowledge, which seems to

support the findings of the current study. Further study into the relationship of ethnicity and environmental literacy is needed, especially in the understudied Hispanic community.

Age and Years of Teaching

The present study found no significant differences between age groupings. It did show a correlation between age grouping and years of teaching ($p < .01$), which would be logical to expect. The age grouping younger than 31 did show a somewhat higher score on the affective subscale, but it was not significant. This may be a result of the renewed interest in the environment and environmental movement of the recent decades. These results were contrary to Owens (2000), who reported increased scores in relation with years of teaching.

Major

Owens (2000) found a significant difference based upon subject areas taught. This would seem to follow reason, especially with science majors more likely to take ecological-type classes. Contrary to the findings of the above-mentioned study, there were no significant differences between the different groups of majors. This could be an artifact of the small number of participants.

Frequently Missed Questions

Analysis of answers given on the cognitive subscale revealed that the participating teachers had adequate knowledge of ecological concepts. Areas for improvement include knowledge of ecological principles involving individuals, populations, and communities, knowledge of environmental problems and issues, and knowledge of environmental issue investigation and action strategies.

Environmental Sensitivity and Attitudes Toward Environment

This study suggests that the participating teachers feel that the environment should be protected. Most teachers felt it was their responsibility to help solve environmental problems and that the things they do have an effect on the quality of the environment. The conflict came when personal freedom was going to be impacted by governmental regulations. When questions involving regulations were answered, respondents were still pro-environment, but the responses where more scattered along the spectrum. These results were similar to those reported by Brehm and Eisenhauer (2006) on their Mormon population. In their study, Mormons showed great concern for the environment, but showed lower perception of importance and stronger opposition to public-land restrictions. Truelove and Joireman (2009) found that Christian orthodoxy was negatively related to willingness to pay for environmental protection.

The statement, "I believe that plants and animals exist to be used by humans," produced a response pattern that was different from the general trend by having similar response rates for *strongly agree, agree*, *no opinion*, and *disagree*. This pattern seems to support White's (1967) idea that nature is there to meet humanity's need and the Judeo-Christian ethic that gives humans the right to do as they see fit with the environment. It is also consistent with findings of Klineberg et al. (1998). But when looked at in the context of the participant's view of the following biblical passage, "God blessed them and said to them, Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground" (Gen 1:28, NIV), it can be explained by the view of the Christian

teacher's belief they are responsible for taking care of the environment. Along with that, there was a minor theme of the earth being a gift from God.

When the responses from the open-ended question were analyzed, clear themes favorable to the environment emerged. This positive view of the environment paralleled the results gotten from the quantitative portion of the survey. The view of humanity being above the other organisms of the earth, but at the same time being responsible for taking care of the environment, was clearly evident. The presence of this concept is consistent with that which was found by others who have studied the views of other Christians (Kanagy & Nelsen, 1995; Kanagy & Willits, 1993; Kearns, 1997; Shaiko, 1987; Shibley & Wiggins, 1997; Wolkomir et al., 1997).

Environmentally Responsible Behavior and Actions

There is a dichotomy between the teachers' affective (attitudes and beliefs) domain and their behavioral domain. Even though the teachers in this study say that protecting the environment is important, most of them also responded that they *never* or *almost never* walk, take public transportation, or ride a bike instead of using a car in order to help protect the environment. They *sometimes* avoid purchasing products that have a negative impact on the environment or purchase products that are over-packaged. This is consistent with the findings that when Christians have a trade-off between environmental interests and economic interests, they show less support for the environment than non-Christians (Eckberg & Blocker, 1996; Greeley, 1993; Hand & Van Liere, 1984; Klineberg et al., 1998). Teachers did report that they *almost always* turn off lights and

appliances to conserve electricity and most of them recycle paper, glass, and/or metal waste products, but this could be for economic reasons, as suggested by Owens (2000).

The teachers in this study choose not to be politically active, as demonstrated by the vast majority who reported that they *never* or *almost never* take the time to write a letter to either a politician or newspaper about environmental views, problems, or issues. The majority of the respondents report that they do not report environmental problems or violations to proper authorities.

The environmental behaviors of the teachers of this study seem to be based more upon convenience than conviction. This leads to an evaluation of their environmental literacy being at a nominal level based on the three levels described by Roth (1992):

> **Nominal environmental literacy** indicates a person able to recognize many of the basic terms used in communicating about the environment and able to provide rough, if unsophisticated, working definitions of their meanings. . . . **Functional environmental literacy** indicates a person with a broader knowledge and understanding of the nature of and interactions between human social systems and other natural systems. . . . **Operational literacy** indicates a person who has moved beyond functional literacy in both breadth and depth of understandings and skills who routinely evaluates the impacts and consequences of actions. (emphasis in original; p. 18)

Summary of Key Findings

1. Teachers in the study revealed nominal environmental literacy with a mean total environmental literacy score of 66%.

2. Teachers in the study scored highest (76%) on the cognitive (knowledge) subscale. Behavioral subscale scores were the lowest (48%) of the three subscale scores. Affective (beliefs and attitudes) subscale scores were 73%.

3. White, Non-Hispanics scored significantly higher ($p < .01$) than did Hispanics on the cognitive (knowledge) subscale.

4. The reported behaviors of the teachers in the study do not necessarily match their beliefs and attitudes.

5. Two prevailing themes teachers presented from their consideration of Gen 1:28 were responsibility for the environment and need to take care of the environment. Two lesser themes were the earth as a gift from God and the earth is there to be used for self-serving needs.

6. The Wisconsin Environmental Literacy Survey (WELS) is a useful, reliable, and valid instrument for use in evaluating environmental literacy of Seventh-day Adventist teachers.

Implications of the Study and Recommendations for Practice

Davidson (2008) points out that "the overwhelming impression gained from Scripture, the sole document on which the Christian faith is established, is that of the aesthetic nature of God flooding His revealed Word and created world" (p. 178). Because of this, Christians, specifically Seventh-day Adventists, should want to take care of the environment. Unfortunately, the teachers of the Florida Conference of Seventh-day Adventists show only nominal environmental literacy. They do not seem to show any differences from the general population of the United States. If the Seventh-day Adventist Church is serious about the need for environmental stewardship within its membership, it should consider ways to improve the existing condition. Teachers with the suitable environmental literacy can widen the impact of environmental education broadly and effectively (UNESCO, 1988), and this could lead to improvement in environmental literacy for generations to come.

The investigation into the environmental literacy of Adventist teachers needs to be done in greater detail. This study should be just the beginning to the understanding of Adventist teachers' knowledge, views, and attitudes in regard to the environment. The data from this study suggest that there is room for further study and development.

The leadership of the educational program of the Florida Conference of Seventh-day Adventists, as well as the leadership of the educational program of the North American Division of Seventh-day Adventists, may wish to give study to creating opportunities for enhanced and ongoing professional development. Such opportunity might focus on improving environmental knowledge and skills in teaching students about environmental issues, including the use of interdisciplinary, field-based, and research-based learning, as well as innovative technology in the classroom. Teachers could be provided with training on ways to provide field experiences as part of the regular school curriculum and to create programs that contribute to healthy lifestyles through outdoor recreation and sound nutrition. It is not just knowledge that the students need to receive, because it has been shown that knowledge does not necessarily translate into attitude change or pro-environmental behavior (Chawla, 1998; Hines et al., 1986/1987; Klomuss & Agyeman, 2002; Marcinkowski, 1989; Sia et al., 1985/1986; Wilke, 1995, Zelezney, 1999).

Apparently, there are few programs that prepare teachers to provide coursework in environmental education and even fewer that require coursework in EE. Teacher preparation programs should require appropriate EE learning so that teachers emerge from training at least at the functional level in environmental literacy. There could be a requirement put in place that a class involving nature-based education be included in the

certification requirements for teachers. Advanced teacher training could result in teachers performing at the operational level.

This study corroborates the idea that a holistic approach is needed to attain greater environmental literacy. There needs to be more than just an increase in knowledge. There also needs to be exposure to the environment so that individuals will connect with the environment, and this exposure will lead to an increase in a change in behavior and attitudes. Culen and Mony (2003) showed that even non-formal outdoor programming increases environmental literacy of students. Providing more knowledge does not necessarily change behaviors and attitudes. Although WELS scores were relatively high for cognitive (76%) and affective (73%) subscales, the behavioral subscale score was low (48%). More research could further explore the reason for this apparent disconnect between what is known and felt as compared to what is actually done. Why are these teachers not deciding to behave in the manner in which they seem to feel that they should?

Environmental education involves more than just scientific understanding. It underscores attitudes, actions, and beliefs. It involves people. These people have attitudes, behaviors, and concerns. Environmental issues involve many things besides just people and their attitudes. They also involve such issues as geography, economics, and race. Teachers should provide more than just a solid science education. They should equip students with life skills so the students can become responsible citizens. Before teachers can do that, however, they need to be trained to do so. This takes more than just the science teachers. It must involve all teachers, regardless of the subject areas they teach. This study could be useful in the advancing of discussion about the need for

environmental education programs in teacher education and the development of such programs.

In final conclusion, this research does not support Lynn White's idea that Judeo-Christian teaching causes anti-environmental attitudes and behaviors. This study seems to show that the teachers of Florida Conference do not show environmental literacy that is very different from the general public, which is nominal. The teachers' knowledge is adequate, and they say that being responsible for the environment and caring for it is part of the biblical message of Gen 1:28, but their behaviors seem disconnected from this belief.

Recommendations for Future Research

This study provides a baseline for further studies and comparisons with other populations. Environmental literacy research needs to be conducted with more groups of Seventh-day Adventist teachers from different geographical regions. Study might be given as to how SDA teachers from other regions compare to those of the Florida Conference of Seventh-day Adventists. Studies comparing SDA teachers with those of other denominations could also be done. More study is needed to determine if there are differences based on ethnic background, gender, and major area of training.

Scientific literacy starts with education. Studies on teacher preparation and teacher characteristics in relation to environmental education are scarce and general in nature. Before this study, the published research did not appear to address the effect that teachers' religious beliefs have on environmental literacy. Similarly, the effect of ethnicity on environmental literacy had rarely been studied. This study looked at differences based on ethnicity. Studies could be done on the amount and kind of

environmental education preparation that teachers receive and the effects that these have on teachers' environmental literacy.

This study focused on Seventh-day Adventist (SDA) teachers. Further analysis of SDA teachers would add to the existing environmental literacy literature. Comparing teacher environmental literacy with student environmental literacy along with Adventist teaching practices could expand the knowledge about environmental literacy levels in the school system of the Seventh-day Adventist church. Continued study of the frequently missed questions or negative patterns of environmental behavior and attitude could help to identify areas of emphasis for teacher preparation and inservice training.

Although the WELS has been shown to be a valid instrument to be used to assess environmental literacy in adults, it is a dated instrument. Questions involving writing letters and reading newspapers might be changed to incorporate more current social-networking response mechanisms. This may result in a change in the response patterns in the behavioral subscale. McBeth and Volk (2010) indicated in their study that newer instruments similar to the Middle School Environmental Literacy Survey could be developed for use in adult populations.

During the period of this study, McBeth and Volk (2010) have proposed a new framework for environmental literacy including ecological knowledge, environmental emotions, environmental sensitivity, issues and action skills, verbal commitment, and actual commitment. This framework is similar to the one used in the study, but does expand on the framework used in this study. It would be prudent for researchers in the future to consider basing their studies on the newer expanded framework.

APPENDIX

SURVEY INSTRUMENT

Instructions for taking the survey:

Today you will taking a survey that asks questions about what you know, think, and do about the environment and environmental issues. Please answer the questions truthfully and to the best of your ability.

You should have received two survey documents (first one with sections I-III, and a second with sections IV and V) and an answer sheet for recording your answers for the first survey document. You will be returning the answer sheet and the second survey document. First, confirm the number on the upper right hand corner of the survey documents and answer sheet are the same. **Do not put your name on any of the documents.** Your answers from the answer sheet and the second survey document will be matched and classified by the number only. It is very important to fill in the documents carefully.

If you would like to make any written comments about any part of the survey, please write them on the back of the answer sheet only. Once you have completed the documents, please **place the answer sheet and second survey document in the envelope provided and return the envelope by mail to the researcher.**

Please remember that the researcher will not know your identity and will not share individual survey results with the conference.

Consent Statement: I have read the informed consent letter and recognize that by completing and returning this survey I am giving my informed consent to participate.

Thank you for taking your time to participate in this study.

Section One

Instructions for Section One: Please indicate how <u>you</u> feel about each statement below. There are no right or wrong answers. Read each statement carefully. Fill in the circle on your answer sheet for the letter that best indicates the extent to which you agree or disagree with each statement, using the following key:

strongly agree	agree	no opinion	disagree	strongly disagree
(a)	(b)	(c)	(d)	(e)

1. I enjoy watching TV programs about nature.

2. When I am outside, I usually don't notice the natural things around me like flowers, trees, and clouds.

3. I'm not interested in reading about nature or the environment.

4. I like hearing the sounds of animals such as birds and insects calling when I'm outside.

5. I think most of the concern about the environmental problems has been exaggerated.

6. Knowing about the environmental problems and issues is important to me.

7. A community's pollution regulations should not interfere with industrial growth and development.

8. I am concerned about the issue of deforestation.

9. I think that damage to the ozone layer is something that everyone should be concerned about.

10. More controls should be placed on industry and agriculture to protect the quality of the environment, even if it means that things that I purchase will cost more.

11. I am not concerned about the fact that the world's deserts are increasing in size.

12. There are already enough laws to protect the environment.

13. I believe that plants and animals exist to be used by humans.

14. I don’t think that recycling is worth all the trouble is takes.

15. I would oppose any environmental regulations that would restrict my way of life.

16. More land should be set aside for wildlife habitats.

17. Environmental restrictions should be lifted so that exploration and production of fossil fuels can be increased.

18. If a person’s car exceeds certain standards for air pollution, he or she should not be allowed to drive it.

19. The government should provide financial support for research and development related to renewable energy, even if it means that taxes will be higher.

20. I am concerned about how much waste is produced in this country.

21. Laws should be passed and enforced that protect the quality of life in the future even if it means that individual freedoms are limited.

22. I am not concerned about the rate of species’ extinction in the world.

23. I am concerned about environmental health hazards such as those caused by air or water pollution.

24. I want to help solve environmental problems.

25. There is not much that I can do that will help solve environmental problems.

26. I believe that I can contribute to the solution of environmental issues by my actions.

27. It’s too hard to change my friends’ minds about doing things to help the environment (for example, recycling).

28. An individual, working on his or her own, can contribute to the solution of environmental problems and issues.

29. Things that I do don’t have much effect on the quality of the environment.

30. I feel that it is my responsibility to help solve environmental problems.

Section Two

Instructions for Section Two: For the following groups of statements, please indicate how frequently you do each of the actions mentioned. Be honest, there are no right or wrong answers. Fill in the circle on your answer sheet for the letter that is closest to your answer, using the following key:

almost always	often	sometimes	almost never	never
(a)	(b)	(c)	(d)	(e)

31. I turn off lights and appliances when they're not being used in order to conserve electricity.

32. I avoid purchasing products that are over-packaged.

33. I talk to people that I notice doing something that harms the environment in an effort to persuade that person to stop that activity. (For example, try to talk a friend into recycling pop cans instead of throwing them in the trash.)

34. I walk, take public transportation, or ride a bike instead of using a car in order to help protect the environment.

35. I make an effort to reduce the amount of goods I consume.

36. I set a positive environmental example for my friends to follow.

37. I support candidates for offices who are concerned about environmental problems and issues.

38. If I see an aluminum can on the ground when I'm out walking, I pick it up and take it with me.

39. I recycle paper, glass, and/or metal waste products at home or at school.

40. I avoid purchasing products that have a negative impact on the environment.

41. I talk to my family and friends about what they can do to help solve environmental problems.

42. I write or call politicians to express my views about environmental issues.

43. I make a point of reading newspaper and magazine articles about the environment.

44. I purchase one product over another product because it is packaged in reusable, returnable, or recycled containers or packages.

45. I send letters to the newspaper about environmental problems or issues.

46. I have reported environmental problems or violations that I have noticed to the proper authorities.

Section Three

Instructions for Section Three: For each of the following questions, choose the **best** answer. Fill in the circle for the letter of the answer on your answer sheet.

47. A food web consists of

    a) the animals that eat other animals in a community.
    b) all the herbivores and carnivores in an ecosystem.
    c) many interconnected food chains.
    d) all the consumers in an ecosystem.

48. When two or more species attempt to use the same limited resource in an ecosystem, their interaction is called

    a) mutualism
    b) competition
    c) predation.
    d) commensalism.

49. Having sharp thorns can help a plant by keeping animals from eating it. This is an example of

    a) mutualism.
    b) adaptation.
    c) competition.
    d) commensalism.

50. All of the individual organisms that live on the ground in a particular forest share the same.

a) niche.
b) habitat.
c) life-style.
d) food source.

51. The reason dead leaves and twigs don't build up in a forest from year to year is because

a) non-living elements such as wind and rain remove them.
b) decomposers break them down into soil.
c) animals eat them or use them to build nests.
d) none of the above.

52. Wolves often eat deer. Does this interaction have any beneficial effects on the deer population as a whole?

a) Yes, the wolves help keep the deer population size controlled.
b) No. The deer population is usually only harmed.
c) Yes, the wolves help keep the deer population strong since the fastest, most alert deer survive.
d) Both (a) and (c)

53. The energy currently present

a) is all the energy we will ever have.
b) can change form but is never destroyed.
c) can only be used once.
d) is mostly in the form of fossil fuel energy.

54. Based upon major ecological principles, we should conclude that

a) humans are a climax species that will last indefinitely.
b) the human species will soon become extinct; nothing we can do will prevent it.
c) the human species will last as long as there is a balanced ecosystem that will support human life.
d) there is no way of predicting what will happen to the human species; ecological principles do not apply to humans.

55. The process of photosynthesis is green plants

a) uses sunlight to burn energy in plants.
b) changes light energy into chemical energy.
c) changes chlorophyll into sugar.
d) is a process used to burn sugar stored in plants so the plants can grow.

56. Which of the following terms is used to describe all of the natural living and nonliving interacting features of a given area?

a) habitat
b) community
c) biodiversity
d) ecosystem

57. Humans grow crops for food. Many species of these plants need certain species of insects (such as bees) to pollinate them. The pollinating insects often rely on the nectar they obtain from the plants for food. This is a good example of

a) how organisms, including humans, are interdependent.
b) commensalism between humans and other species.
c) how humans manipulate their environment.
d) a food web that includes humans.

58. A particular aquatic ecosystem is contaminated by a chemical which tends to remain stored in body fat. The highest concentration of this chemical would most likely be found in which group of organisms in the ecosystem?

a) plant life
b) minnows
c) fish that eat insects and plants
d) fish-eating birds

59. Which of the following phrases refers to the potential ability of a system to support population growth without harming the environment?

a) carrying capacity
b) species loading
c) non-sustainable growth
d) all of the above

60. In a small lake, a food chain was as follows:

sun → green algae → small crustaceans → fish

After many months of heavy snow covering the ice, most of the small crustaceans died. What is the best explanation for this?

a) The algae population was cut off from its source of energy.
b) It was too cold for the crustaceans to survive.
c) The fish ate most of the crustaceans.
d) A disease killed most of the algae.

61. If carbon dioxide (CO_2) disappeared from the atmosphere, which of the following would be affected first?

a) plants
b) animals that eat plants
c) animals that eat other animals
d) decomposers

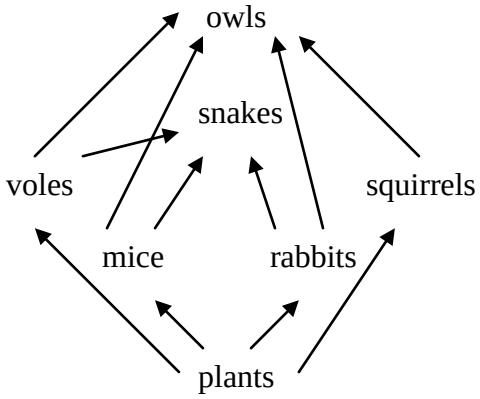
62. Each of the following food chains starts with the same amount of green plants. Assuming that the green plants are digestible by humans, which of the food chains would supply the most energy to humans?

a) green plants to humans
b) green plants to cattle to humans
c) green plants to insects to fish to humans
d) green plants to insects to small fish to larger fish to humans

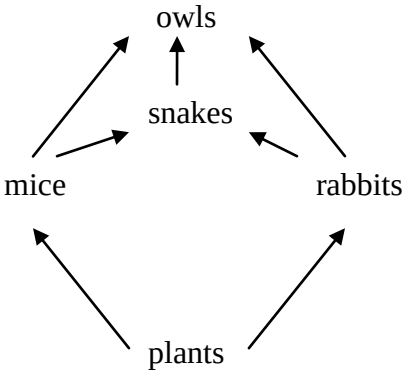
63. Some insecticides that were once effective in killing insects no longer work very well. This is because

a) new insects species develop every day.
b) the wrong kind of insecticides were used.
c) insects with natural resistance survived and multiplied.
d) the insects produced many more offspring than the insecticide could kill.

64. Which of the food webs below would be affected the <u>most</u> if all the mice were removed? (Note: the arrows point to the consumer of the organism in the food web.)



Food Web (A)



Food Web (B)

a) food web (A)
b) food web (B)
c) Neither would be affected
d) They would both be affected to the same degree.

65. Which of the following contributes to air pollution at the surface of the earth, and acts as a shield against ultraviolet rays in the upper atmosphere?

a) nitrous oxide
b) methane
c) ozone
d) sulfur dioxide

66. The main source(s) of emissions that have been identified as contributing to acid deposition (acid rain) in the United States are

a) volcanoes and forest fires.
b) petroleum refineries.
c) automobiles and coal burning power plants.
d) aerosol sprays and refrigerant leakage.

67. Which of the following is **not** true of the world's human population?

a) It is expected to double within your lifetime.
b) It is declining in developed areas such as the United States and Canada.
c) Its increase has led to the extinction of many plants and animal species.
d) The greatest rate of population growth is occurring in developing areas such as South America and Africa.

68. The future of food production as it is currently practiced in this country is in question because

a) soil is being depleted by erosion.
b) the use of synthetic chemical additives has become an issue.
c) agricultural land is being lost to development.
d) all of the above.

69. Which of the following would be **most** likely to cause groundwater pollution?

a) organic farming practices
b) municipal composting of yard wastes
c) adding too much fertilizer to fields
d) wastewater treatment plants

70. The rate of species' extinction is higher now than at any time since the period of the dinosaurs' extinction. The **main** cause of this rapid decline in biodiversity is

a) habitat alteration by humans.
b) the illegal poaching or collecting of animals and plants.
c) changes in the earth's atmosphere due to human activities.
d) hunting by humans for food or sport.

71. Which of the following do scientists feel is the **least** important contributor to the greenhouse effect?

a) destruction of the earth's rainforests
b) burning of fossil fuels, such as gasoline and oil
c) increased use of hydroelectric power
d) production of methane gas by cattle and rice paddies

72. Most municipal solid waste in the United States is presently disposed of by what method?

a) burning it in closed incinerators
b) recycling
c) shipping it out to sea and dumping it
d) burying it in landfills

73. Which of the following is **NOT** a major water pollutant?

a) bacteria
b) pesticides
c) heat
d) All of the above are major water pollutants

74. One suggested advantage of using nuclear power plants for energy production is that

a) nuclear power plants are not expensive to build
b) the waste products are fairly easy to store
c) there is less air pollution
d) they are totally safe.

75. Which of the following results in the most serious waste or loss of our usable water?

a) contamination by bacteria
b) uncontrolled drainage
c) careless usage
d) improper storage

76. Which of the following would be most likely to result in soil erosion?

a) an increase in nutrients added to the soil
b) the removal of vegetation
c) contour plowing of hillsides
d) aeration of the soil by bacteria

77. Which of the following is considered to be a non-renewable energy source?

a) oil
b) wood
c) biomass
d) none of the above

78. Which of the following is a naturally occurring, invisible gas which can seep out of the ground into people's homes and cause serious health problems?

a) ethane
b) krypton
c) radon
d) chlorofluorocarbons

79. A major nuclear accident occurred in 1986 at the _____ nuclear power plant.

a) Belgrade
b) Nagasaki
c) Chernobyl
d) Three Mile Island

80. Which of the following offers the most potential for reducing our immediate energy problems?

a) geothermal power
b) energy conservation
c) biomass conversion
d) tidal power

81. Having your household water tested is important if

a) you live in an old house.
b) your water comes from a well.
c) you live in an agricultural area.
d) all of the above.

82. Which of the following is <u>most</u> likely to help endangered species?

a) Outlaw the sale or possession of endangered species or products made from them (skins, furs, ivory, etc.).
b) Create breeding programs in zoos for endangered animals.
c) Use farming methods which do not damage habitat.
d) Maintain large protected natural areas where they live.

83. <u>In the long term</u>, which of the following would be the **<u>best</u>** way to lessen the problem of solid waste?

a) Incinerate waste materials.
b) Reduce the amount of materials being consumed.
c) Reuse materials for other purposes rather than throwing them out.
d) Recycle materials that can be used again.

84. Which of the following would be the most effective method of influence a large number of people to take action about an environmental problem?

a) Advertise on the radio
b) Write letters to the newspaper.
c) Go door to door and talk to people.
d) Use a combination of the above.

85. If your student environmental club was concerned about an environmental issue, which of the following would be the best thing to do **first**?

a) Write and circulate a petition about the issue
b) Talk to other people about what they could do to help resolve the issue.
c) Write to elected officials about your concern.
d) Research the issue.

Section Four

Demographic Data

Instructions for Demographic Section: All of the data you provide while completing this survey is strictly confidential. Only you and the researcher will know how specific questions were answered. Because of this, please be completely honest in your responses to all sections of the survey. Please circle your answers

86. What is your gender?

    1. Female
    2. Male

87. What is your racial/ethnic background (circle all that apply)?

    1. American Indian/Alaska Native
    2. Asian/Pacific Islander
    3. Black, non-Hispanic
    4. Hispanic
    5. White, non-Hispanic
    6. Other (Please specify) _____

88. How old are you?

    1. Under 31
    2. 31-40
    3. 41-50
    4. 51-60
    5. 61+

89. How many years have you been teaching?

    1. 1 to 5 years
    2. 6 to 10 years
    3. 11 to 15 years
    4. 16 to 20 years
    5. 21 to 25 years
    6. Over 25 years

90. When you attended college, what was your academic major?

    _____

91. What do you consider as your teaching field of specialization (grade level and subject area?

_____

92. Please provide your best estimate of your level of environmental literacy:

"knowledge about and attitude toward the environment that allow you to behave in an ecologically sustainable manner."

1	2	3	4	5
very low	low	moderate	high	very high

Section Five

93. In the space provided below, please share your interpretation of the following verse:

God blessed them and said to them, Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground. (Genesis 1:28 NIV)

94. How does your interpretation impact on your view of your role in relationship to the environment?

95. In what ways does your interpretation affect your methods of teaching or the content that you teach?

This is the end of the survey. Thank you for your participation!

Note: Only the answer sheet and Sections IV and V should be returned in the sealed envelope provided. Sections I-III of the survey may be discarded. Thank you again for taking the time to complete and return the survey!

REFERENCE LIST

REFERENCE LIST

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