

An Examination of the Impact of Non-formal and Informal Learning on Adult
Environmental Knowledge, Attitudes, and Behaviors.

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Thank you Dr. Tony Murphy and Denise Stromme for sharing the data set for *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior*.

DEDICATION

This dissertation is dedicated to the thoughtful, interesting, and funny guides I have encountered at the many academic crossroads of life. I have been inspired by our friendships, laughter, and profound conversations.

ABSTRACT

The purpose of this research is to consider the environmental knowledge, attitudes, and behaviors, of adults in Minnesota, and possible factors that influence environmental literacy. Specifically, this study is designed to: (1) measure the environmental literacy of Minnesota adults, (2) explore possible relationships between Minnesota adults' environmental literacy variables and their demographic, non-formal and informal learning, and (3) determine the relative contribution of demographic and learning variables for predicting environmental knowledge, attitudes and behaviors.

This research was accomplished by conducting a secondary data analysis of *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008). Phone interviews were completed between August and November 2007 with one thousand adults throughout Minnesota.

Findings indicated that for age, education, and income, there was a weak positive relationship with environmental knowledge, attitude and behavior scores. There was a significant effect for gender and environmental knowledge scores, with males receiving higher environmental knowledge scores than females. There was a significant effect for gender and environmental attitudes, and behavior scores as well, with females receiving slightly higher environmental attitude and behavior scores than males. After controlling for the effects of demographic variables on environmental knowledge, attitudes and behaviors, non-formal learning participation appears to be a moderate contributor to both environmental knowledge and environmental behaviors. After controlling for the effects

of demographic variables on environmental knowledge, attitudes and behaviors, informal learning participation appears to be a slight contributor to environmental attitudes, and a moderate contributor to environmental knowledge and behaviors.

Overall, the results of this study suggest that participation in non-formal and informal education venues improved environmental knowledge, attitude and behavior models, providing evidence for the value and need for non-formal and informal environmental adult education venues.

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CHAPTER 1 - INTRODUCTION

While working on my masters of public administration in the late 1990s I chose to study the proposed high-level nuclear waste repository site at Yucca Mountain in Nevada for an assignment. I chose this topic since I knew it included elements of public administration, politics, and interested citizens (commonly referred to as the iron triangle). Politicians had been arguing for and against how to best handle America's then 40 year backlog of highly radioactive nuclear power plant waste. A decision was made at the federal level that a possible good solution was to drill a large underground tunnel system somewhere in America, transport the high-level nuclear waste from wherever it was being stored through at least 45 states, store and monitor the waste at the new site for a time, and then decommission the site and leave it forever with signage warning off future generations for the next 10,000 years. Studying the realities of this project through an iron triangle framework really clarified the complex and interconnected relationships of public administrators, politicians, and citizens. A surprising outcome of the assignment was how little the American citizens, cited in the research at the time, knew about this topic even though it was clear that a federal decision would impact almost every state in America, as well as impact the environment for American citizens for approximately the next 10,000 years. This research left the lingering question of who is responsible for ensuring informed citizenry anyway? This also eventually led to my academic interests in adult education with its focus on adult learning and community related education aspects that would allow me to further my research interests and efforts on understanding adult literacy and the environment. This study will explore environmental adult literacy.

Background

Adult education can be characterized as the teaching efforts targeted at adults and the learning that occurs in adulthood. To focus instructional efforts, educators and coordinators must choose and utilize support material based on their assumptions of what their learners need. For example, learning support materials for adults can be chosen to target a specific subject at a university or college, to support learners in Adult Basic Education (ABE) or English Language Learning (ELL), to support career growth and job skills, and even to support personal development at local community education centers, environmental learning centers, or elsewhere. Adult learners also make education choices based on needs, such as a need for professional development (academic or workplace, required or optional), or a need for personal development (not necessarily related to work attainment). Adult learners also have to decide and choose how, when, and where, they will engage in their learning. The aims of all of these adult education options, requirements, and opportunities mentioned above are the same – to support adult learning.

As an adult educator, knowing some of the background information mentioned above can offer directional insight for better targeting learners' literacy needs. Helping learners to become literate in topic areas being taught is expected. To meaningfully assist learners in becoming literate, educators also need to clarify what being literate means.

One way to consider what literate means in a general sense is by looking at the National Literacy Act of 1991. Here *literacy* is defined as, "an individual's ability to read, write, and speak in English, and compute and solve problems at levels of proficiency

necessary to function on the job and in society to achieve one's goals, and develop one's knowledge and potential" (National Literacy Act of 1991, Sec. 3). The expectations for being literate in this sense go beyond citizens having basic reading, writing, and speaking skills in a country's dominant language. The clause, "compute and solve problems at levels of proficiency necessary to function on the job and in society" (National Literacy Act of 1991, Sec. 3) is significant and imperative for developing citizenry who can understand, make informed decisions, and also act on the many complex topics and issues in society today. One of the complex areas that citizens need to make decisions about in our society is the environment.

The confluence of an adult's knowledge about, and attitudes, and behaviors toward, the environment are sometimes referred to as environmental literacy (Coyle, 2005; Murphy, 2002; Murphy, 2004). The North American Association of Environmental Educator's (2004) defines environmental literacy as:

Environmental literacy is possessing knowledge about the environment and issues related to it, and being capable of and inclined to further self-directed environmental learning and/or action.

This definition aligns well with past and current research efforts in the area of environmental knowledge, attitudes, and behaviors (KABs) since this definition considers environmental literacy to include a person's knowledge about the environment and related issues, as well as a person's inclination to further self-directed environmental learning and action (tied to their attitudes and pro-environmental behaviors). The North American Association for Environmental Education (2004) definition of environmental

literacy and the National Literacy Act's (1991) definition of literacy both include references to people having the knowledge they need in order to act. The focus of this dissertation research is to consider the environmental literacy of adults, specifically adults in Minnesota, and the possible factors that influence environmental literacy.

Researchers' efforts to consider adults and the environment have been ongoing and raise the issue of why there has not been a steady improvement in the state of our natural environment despite environmental education's efforts of the past several decades. Since environmental education has been available, and used, in primary and secondary education for the past thirty years, it does spark interest in whether, and how, environmental education efforts might influence adults and their environmental literacy. In addition to formal teaching and learning venues such as environmental education in colleges and universities; non-formal environmental teaching and learning venues have been available in environmental learning centers, interpretive facilities, state, county, and city parks, national wildlife refuges, arboretums, botanical gardens, museums and zoos. Informal environmental education venues such as the newspapers, magazine, television, the internet, and conversations with friends and family, have all been available for children and adults interested in learning about the environment and environmental issues too. However, despite all of this, and even citizen professed interests in the environment and environmental issues, adult environmental literacy is lacking and has shown few signs of improvement over the past decade according to national and state-wide research studies in America (Coyle, 2005; Donovan, G., 2001; Mancl, Carr & Marrone; 1999; Murphy, 2002; Murphy, 2004; National Environmental Education & Training

Foundation, 2001; Pennsylvania Center for Environmental Education, 2001; RoperASW, 2002). Multiple factors influence adult literacy regarding the natural environment and environmental issues. Few studies consider these influencers for adults as a population. As Merriam, Caffarella, & Baumgartner (1999) highlight, “to facilitate the process of learning, it is especially important to know who the adult learner is, why adults are involved in learning activities, how adults learn, and how aging affects learning ability” (p. xi). While this study will not cover all of these areas, knowing possible influencers can help educators better understand their adult learners, track trends in environmental literacy at state and national levels, and can be utilized to target environmental adult education efforts.

A survey that was designed to consider environmental literacy in Minnesota is the *Minnesota Report Card on Environmental Literacy: A Benchmark Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy, 2002). For this report a telephone survey was used to poll 1,000 adults in Minnesota to collect data on their environmental knowledge, attitudes, and behaviors. A second similar Minnesota report card of adult environmental literacy was also completed by Murphy in 2004. It is data from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) that will be used here to continue efforts to explore the significance of demographics (age, education, income and gender), and learning (non-formal and informal learning) on Minnesota participants’ environmental knowledge, attitudes, and behaviors or their environmental literacy.

Problem Statement

While it can be assumed that industry and other large scale operations are a main cause of environmental degradation, individual citizens, and decisions made at an individual level, do have a significant impact on our natural environment also. Coyle (2005) posits that environmental problems caused by individuals are not only a problem; environmental problems caused by individuals are on the rise. This is concerning if individual citizens do not see that their individual decisions and actions are part of environmental degradation problems. How then might we help individuals see that they can and do make an impact? Blake (2001) found with adults that “where the culprit is clear and a solution to the problem seems within the power of individuals to achieve, environmental action is more likely to occur” (p. 717). This is promising research since it indicates that if citizens can recognize when they are culprits and that they have the power to do something, then environmental action is more likely to occur. This also highlights why it is imperative that environmental issues are clarified in ways that individual citizens can understand that their individual impacts and actions do matter, and that individual actions can influence positive environmental health.

Many research studies involving environmental knowledge, attitudes, and behaviors (KABs) of individuals have been carried out in environmental education and related areas (Coyle, 2005; Franzen, 2003; Holden, 1995; Murphy, 2002; Murphy, 2004; National Environmental Education & Training Foundation, 1997; National Environmental Education & Training Foundation, 1998; National Environmental Education & Training Foundation, 2001; Pennsylvania Center for Environmental

Education, 2001; Scott & Willits, 1994; Smith, Rechenberg, Cruey, Magness & Sandman, 1997). However, relatively few have specifically addressed KABs of general adult audiences and the possible factors that might influence the general adult populace and their KABs. Understanding general adult audiences is critical since adults everywhere are making and acting on decisions that directly affect the environment every day. For instance, adults typically decide the transportation options for themselves and their families, whether to use fertilizer or herbicides on their lawns or gardens, and when options are available, how daily disposal of their waste using dumpsters, composting, or recycling will be carried out. Adults also have significant influence on political officials' decisions regarding local, state, and national environmental use and issues. All of these individual and collective decisions and behaviors impact environmental quality. All of these decisions and behaviors are informed by the knowledge adults have about the environment, and their attitudes toward the environment.

In addition to this, the importance of addressing environmental KAB goals for the adults and pupils of Minnesota is recognized and mandated in the Minnesota environmental education goals and plan Statute (Appendix A). With Minnesota and other state government backing, and the expectation that environmental education be carried out for its local citizens, it could be assumed that environmental KAB scores should reflect environmental education efforts. As mentioned however, in spite of the formal, non-formal and informal environmental education efforts, adult environmental literacy is lacking according to national and state-wide reports (Coyle, 2005; Murphy, 2004; Pennsylvania Center for Environmental Education, 2001; National Environmental

Education & Training Foundation, 2001). A main concern suggested in these, and related research, is that people's lack of knowledge about the environment combined with their attitudes and behaviors toward the environment are less than what is assumed is minimally necessary for making informed decisions regarding pro-environmental behavior and actions.

Environmental educators and researchers have long been interested in knowledge about and attitudes toward the environment since it was assumed that knowledge and attitudes significantly influence pro-environmental or lack of pro-environmental behaviors (Coyle, 2005; Kollmuss & Agyeman, 2002; Koupal & Krasny, 2003; Smith, Rechenberg, Cruey, Magness & Sandman, 1997). Therefore, taking a myopic view of knowledge and attitudes to try to clarify influencers of pro-environmental behaviors, and even the influencers of knowledge and attitudes, can support environmental education efforts for encouraging adults to act or behave in more pro-environmental ways. If for instance research indicated that environmental KAB scores from questionnaires were higher depending on demographics such as age, level of education attained, income or gender, this could help educators better understand their adult learners. As mentioned early on, through understanding our learners, support materials can be chosen to better target specific audiences. If research also indicated that adult learners who sought out non-formal and informal environmental learning opportunities had higher KAB scores, they can better direct efforts in and encourage these environmental education venues. These in turn then could lead to increasingly useful environmental adult education, more pro-environmental/environmentally friendly behavior, and decreasing environmental

degradation. While this has not happened on a large scale to date, research has uncovered an increasing amount of information on adults' environmental KABs as well as other factors that positively or negatively influence pro-environmental behavior.

Of note is a skepticism in the field of environmental education over the aims of environmental education and whether their purpose should be targeting behavior change, knowledge improvement, attitude change, a combination of these, or something else (Courtenay-Hall & Rogers, 2002; Holsman, 2001; Independent Commission on Environmental Education, 1997). While it is not the intention that this debate on the aims of environmental education will be settled here, underlying environmental education efforts is the encouragement of pro-environmental behaviors (Courtenay-Hall & Rogers, 2002; Culen, 1998; Holsman, 2001; Hungerford, Peyton & Wilke, 1980; Jensen, 2002; Kollmuss & Agyeman, 2002). Consequently, considering the possible influences for increasing pro-environmental behaviors for adults will be considered important for supporting environmental adult education efforts in this research.

While there have been many research studies done on environmental knowledge, attitudes, and behaviors, adults as a targeted and stand alone audience for environmental education remains a fairly young research and education realm. What is encouraging is that one of the five main themes identified for increased education research by the Office of Educational Research and Improvement in the U.S. Department of Education is that of adult learning and environmental education (Smith-Sebastio, 1998). Researchers have also called for an increase in focused efforts on teaching environmental education to adults due to the apparent lack of environmental knowledge and pro-environmental

behavior among adults (Clover, 2002a; Environmental Education Training Partnership, 2004; Whelan, Flowers & Guevara, 2004). Additionally Cullen (1998) identified that, “a greater knowledge base within environmental education concerning the relationships between knowledge, attitudes and behaviors is needed” (p. 40). So considering adults and their environmental literacy, answers this call, and, addresses the need for further research in this area.

Furthermore, research indicates that there is a gap or imbalance in research done in the area of environmental adult education. Whelan, Flowers and Guevara’s (2004) survey of four environmental education journals, in an attempt to identify the extent of research published on community, popular, and informal environmental education yielded their comment that, “the paucity of research in community, informal and popular education contrasts strikingly with national and international consensus concerning pathways to sustainability” (Whelan, Flowers & Guevara, 2004). This makes it an exciting time to be working, researching and studying in this area which considers not only aspects of knowledge, teaching and learning across a person’s adult lifespan, but also formal, non-formal and informal education venues.

Considering environmental literacy for adults based on research literature that positions their knowledge and understanding at a particular place and point in time, as well as, what influences possibly affect their KABs and pro-environmental or lack of pro-environmental behavior, can clarify any gaps and help better target environmental education efforts.

Purpose of Study

In order to proceed with a goal of an environmentally literate citizenry in Minnesota several aspects need to be in place:

- Recognition that there might be pressing issues with the current state of environmental literacy of adults in Minnesota
- An assessment of the current position of environmental literacy of Minnesota adults and the possible influencers on their KABs
- Use of this data to determine any trends or gaps to better target future EE efforts in Minnesota, and help create a paradigm for improvement
- Educators, administrators, politicians and citizens acting individually and collectively to support this vision

The purpose of this research is to examine the impact of non-formal and informal learning on adult environmental knowledge, attitudes, and behaviors. Specifically, this study is designed to: (1) measure the environmental literacy of Minnesota adults, (2) explore possible relationships between Minnesota adults' environmental literacy variables and their demographic, non-formal and informal learning, and (3) determine the relative contribution of environmental literacy variables for predicting environmental knowledge, attitudes, and behavior. The research will be accomplished by conducting a secondary data analysis to consider the first three aspects mentioned. This secondary data research study will analyze the survey and demographic data from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) to explore what factors might positively

and negatively influence environmental understanding, and pro-environmental behavior as indicated by KAB scores.

Significance of the Study

There are several ways this research is adding to the body of knowledge on adult environmental KABs, and can support environmental adult education efforts. First of all, as mentioned earlier, researchers have indicated that there is a gap or imbalance in research done in the area of environmental adult education as evidenced by Whelan, Flowers and Guevara's (2004) survey of four environmental education journals in an attempt to identify the extent of research published on community, popular, and informal environmental education. Their analysis of these journals yielded their comment that, "the paucity of research in community, informal and popular education contrasts strikingly with national and international consensus concerning pathways to sustainability" (Whelan, Flowers & Guevara, 2004). Community, informal, and popular education, in their analysis, refers to learning targeted at general adult populations. When this lack of research on adults and their environmental KABs is combined with Merriam and Caffarella (2007) statement that, "for the first time in our society adults outnumber youth, there are more older adults...and the population will continue to age" (p.7), there is clearly a need to focus research efforts on adults to address the issues, trends, and needs of adult populations.

In addition to this, of the studies that are available relating to the environment and adults, relatively few have specifically addressed KABs of general adult audiences, such

as the Murphy and Olson (2008) study, and the possible factors that might influence adult environmental KABs. Coyle (2005) also remarks on why this is significant:

Moreover, as environmental topics and problems become more complex and pervasive, our decades of reliance on trained experts within the private and public sectors to handle our needs are nearing an end. In the future, many leading environmental problems, ranging from water quality to ecosystem management, will require the efforts of more skilled non-experts acting as individuals, through small business, or as community leaders (p. 79).

Also, the state report, *A GreenPrint for Minnesota: State Plan for Environmental Education*, Minnesota Office of Environmental Assistance and Minnesota Environmental Education Advisory Board (2008) identifies 12 priority audiences. Of these priority audiences: business communities, Government officials and boards, teachers, higher education students, and producers/landowners, many are clearly adult only audiences. The Greenprint also identifies several other priority audiences that include adults: citizen and youth groups, consumers, families, media, outdoor recreation resource users, and religious groups. This study can support Minnesota environmental educator efforts by identifying a baseline of adult environmental KABs in Minnesota.

This research study also allows for comparison of adult KABs with related research studies. Since several studies indicated that there is a positive but weak association between: increased environmental knowledge, a positive environmental attitude, and behavior changes to protect the environment (Coyle, 2005; Koupal & Krasny, 2003; Smith, Rechenberg, Cruvey, Magness & Sandman, 1997), correlating these

variables from the Third Minnesota Report Card on Environmental Literacy allows for comparison with these and other related studies.

Only a few research studies were found that consider correlations between adult KABs and their participation in non-formal and informal education venues.

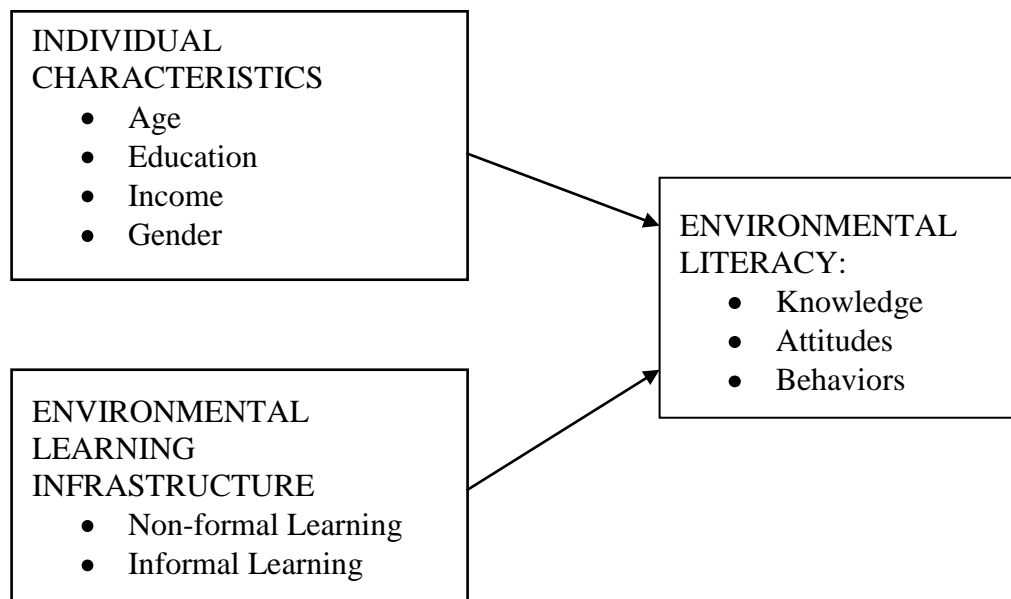
Finally, it can be difficult for policy leaders to recognize the need and importance of environmental education for adults if they don't understand the gaps or recognize the environmental education needs of our increasing adult population.

Research Question and Hypothesized Model

The following question guides this research study: *What is the influence of demographics, and non-formal and informal learning on Minnesota adults' KABs?*

Figure 1 represents the variables used in this study.

Figure 1: Influences on Environmental Literacy



Research studies that consider environmental knowledge, attitudes, or behaviors (or combinations of these) usually include data about age, education, income levels, and gender, which can be used comparatively.

The research sub-questions proposed to explore the influence of demographics, and non-formal and informal learning on Minnesota adults' KABs for this study are:

Question 1: *What is the relationship between an individual's generation (age range) and their KAB scores?*

Question 2: *What is the relationship between an individual's level of education and their KAB scores?*

Question 3: *What is the relationship between individual adults' income levels and their KAB scores?*

Question 4: *What is the relationship between gender and KAB scores?*

Question 5: *What is the relationship between individual adults' participation in non-formal learning and their KAB scores?*

Question 6: *What is the relationship between individual adults' participation in informal learning and their KAB scores?*

Limitations and Delimitations

A limitation of using secondary data analysis is that the researcher is limited to another researcher's existing data set.

Multiple regression will be used as part of the data analysis. A conceptual limitation of regression is that it is possible to only ascertain relationships, but not underlying causal mechanism (Gall, Borg & Gall, 1996; Statsoft Inc, 2003).

Self-reported perceptions from the participants are used to identify and report the participants' attitudes regarding certain environmental laws and regulations, their behaviors, as well as their participation in non-formal and informal environmental learning. The potential exists for biased responses in self-report measures in research studies "...because people tend to overrate themselves" (Holton & Burnett, 1997, p. 74).

Terminology

Adult: for the scope of this dissertation, adults are considered persons age 18 and older.

Adult literacy: defined as "an individual's ability to read, write, and speak in English, and compute and solve problems at levels of proficiency necessary to function on the job and in society to achieve one's goals, and develop one's knowledge and potential" (National Literacy Act of 1991, Sec. 3).

Baby Boomer Generation: individuals born in the years from 1946 through 1964.

EE: environmental education

Environmental attitude: environmental attitudes in the Minnesota reports on environmental literacy (Murphy, 2002, 2004; Murphy & Olson, 2008) are identified as the adults' attitudes toward state and federal environmental laws and regulations.

Environmental behavior: environmental behaviors in the Minnesota reports on environmental literacy (Murphy, 2002, 2004; Murphy & Olson, 2008) are identified as the adults' behaviors (daily and longer term) related to the environment.

Environmental knowledge: environmental knowledge in the Minnesota reports on environmental literacy (Murphy, 2002, 2004; Murphy & Olson, 2008) is identified as what participants actually know about the environment.

Environmental literacy: environmental literacy is possessing knowledge about the environment and issues related to it, and being capable of and inclined to further self-directed environmental learning and/or action (North American Association for Environmental Education, 2004).

Formal education: education that occurs in venues such as environmental education in colleges and universities. (Merriam and Caffarella, 1999, p. 25).

Generation X: individuals born in the years from 1965 through 1978.

Generation Y: individuals born in the years from 1979 through 2000.

Informal education: "Refers to the experiences of everyday living from which we learn something" (Merriam and Caffarella, 1999, p. 25). This includes education that occurs due to participant involvement with internet, newspapers, magazines, television, radio, conversation with friends or neighbors, and conversations with children about their environmental learning experiences.

KABs: knowledge, attitudes, and behaviors

Non-formal education: "Refers to organized activities outside educational institutions, such as those found in learning networks, churches, and voluntary associations"

(Merriam & Caffarella, 1999, p. 25). This includes education that occurs due to participant involvement with government agencies; conservation or environmental groups; environmental learning centers, including nature centers, parks, science museums; and zoos.

Silent Generation: individuals born in the years from 1900 through 1945.

CHAPTER 2 – LITERATURE REVIEW

An important goal of this research is to understand the current environmental knowledge, attitudes, and behavior (KABs) trends of Minnesota adults as indicated in the Third Minnesota Report Card on Environmental Literacy. The confluence of an adult's knowledge about, and attitudes, and behaviors toward, the environment are sometimes referred to as a person's environmental literacy (Coyle, 2005; Murphy, 2002; Murphy, 2004; Murphy & Olson, 2008), and development of environmentally literate citizenry is the aim of environmental education (Culen, 1998; Disinger & Roth, 1998; Hungerford & Tomera, 1985; Moody & Hartel, 2007; Roth, 2008; Volk & McBeth, 1998). However, before designing effective education programs it is necessary to investigate the variables that are important in the development of environmental literacy. This review will summarize the makeup of adult environmental literacy research. Of note is that research from the field of adult education was not purposefully excluded from this overview and is not extensively covered. The search terms used for this literature review: environmental knowledge; environmental attitudes; and environmental behavior; did not yield any published research in the adult education literature. This indicates that there may be a gap in the research published on the area of environmental KABs by adult education researchers, or that the search terms are different in the two education fields, or research efforts are directed in other areas of the environment and adults (this will be discussed later) in adult education literature.

Review Structure

Environmental knowledge, attitudes, and behaviors have been studied in a variety of ways in environmental education and related literature since the terms, knowledge, attitudes, and behaviors, are somewhat ambiguous, and can therefore be focused on for different reasons across different fields. A brief review of literature focusing on environmental knowledge, environmental attitudes, and environmental behaviors, primarily from environmental education literature, will be considered first. Next, information regarding demographic data (such as age, education, income, gender, informal, and non-formal education), and, environmental knowledge, attitudes, and behaviors will be highlighted. Thirdly, a review of the environmental literacy will be included. To align with reports and other research in this area, adults will be considered persons age 18 and older, or, persons attending colleges or universities. Literature results that focused on pre-kindergarten (pre-K) through 12th grade populations are generally excluded from this overview since these fall outside of the target population, and, meta-analysis emphasizing the environmental education research on pre-K through 12th grade and KABs and related areas have recently been conducted by Hart and Nolan (1999), and Rickinson (2001).

Environmental Knowledge

There are several studies that focus on basic or general environmental knowledge of adults (Benton, 1994; Hsu & Roth, 1996; Hughes & Saunders, 2005; Kaplowitz & Levine, 2005; Kennedy, Hyde & Karney, 2002). How a person's knowledge about the environment impacts or influences pro-environmental attitudes or behaviors,

environmental knowledge, and possible relationships with ecologically or environmentally friendly attitudes and behavior, is not fully clear based on research to date. Literature on environmental knowledge usually includes demographics, so it is often possible to compare knowledge scores and demographic data from survey questionnaires. One example of this is a research study that was conducted to consider the environmental knowledge of university students at Michigan State and relationships between their environmental knowledge and demographic information (Kaplowitz & Levine, 2005). These researchers compared their results to environmental knowledge and demographic information from similar national studies on environmental literacy (National Environmental Education & Training Foundation, 1997 & 2001). Significant in these studies was the low environmental knowledge scores for both the university students, and, the national adult populations sampled. A key concern in environmental education research and related literature aligns with the findings from the Michigan State study (Kaplowitz & Levine, 2005) and national studies (Coyle, 2005; National Environmental Education & Training Foundation, 1997 & 2001). Coyle (2005) considered ten years of environmental literacy research in the U.S. and found, “after three decades of school-based environmental education programs, only one-third of American adults can pass a simple test of environmental knowledge with a grade equivalent to A, B, or C” (9 questions or more answered correctly out of 12)(p.3). This can be compared to Murphy’s (2002) study which indicated that 46% of Minnesota adults can answer nine questions or more out of 14 fact based environmental knowledge questions (the report suggested this is similar to a grade equivalent of at least a C). This percentage increased

to 50% by the second Murphy (2004) report with Minnesota adult's passing a factual environmental knowledge quiz with a grade equivalent in their report to an A, B or C (seven questions or more answered correctly out of 13). While this appears to indicate that Minnesotans do better on answering factual environmental knowledge questions compared with adults from the National report (Coyle, 2005), it should be noted that the questions are not all identical in these studies, nor are the letter grade scales identical. However, these studies do all indicate that less than 50% of Americans correctly answer half of the environmental knowledge questions in the national and state quizzes. Why environmental knowledge matters will be considered next.

Overall, the environmental knowledge studies suggest that adult environmental knowledge is lacking and of concern since basic environmental knowledge is recognized as important for informing or affecting positive environmental attitudes and-or positive environmental behaviors (Abdul-Wahab, 2008; Fraj-Andrés & Martínez-Salinas, 2007; Frick, Kaiser & Wilson, 2004; Maloney & Ward, 1973; McDaniel & Alley, 2005). Several studies have found a positive but weak association between: increased environmental knowledge, a positive environmental attitude, and behavior changes to protect the environment (Coyle, 2005; Koupal & Krasny, 2003; Smith, Rechenberg, Cruey, Magness & Sandman, 1997). Part of the relationship can be seen from Coyle's (2005) report data that showed environmentally knowledgeable people are:

- 10% more likely to save energy in the home
- 50% more likely to recycle
- 10% more likely to purchase environmentally safe products

- 50% more likely to avoid using chemicals in yard care

Therefore, having only one-third of American adults able to pass a simple test of environmental knowledge could be a problem supporting and increasing pro-environmental efforts for adults. At the same time, clarifying what adults actually know or do not know about certain environmental topics or issues from surveys can help researchers examine and better understand KAB relationships.

Many environmental knowledge studies rely on survey questions relating to basic environmental facts from the questionnaires and whether these questions were answered correctly or not (Coyle, 2005; Mancl, Carr & Morrone, 2003; McDaniel & Alley, 2005; Murphy, 2002; Murphy, 2004). Other environmental knowledge research separates environmental knowledge into different kinds or types of knowledge. For example, several studies focused on concrete environmental knowledge, and found that higher concrete knowledge scores positively correlated with shaping recycling behaviors (Gamba & Oskamp, 1994; Simmons & Widmar, 1989; Vining & Ebreo, 1990). Frick, Kaiser and Wilson (2004) separate environmental knowledge into three areas or categories: system knowledge (having a basic understanding of a problem), action-related knowledge (knowing what can be done about a problem), and effectiveness knowledge (knowing about the benefit of environmentally responsive actions). They suggest that understanding and targeting all three knowledge areas can better help environmental education programs and educators promote pro-environmental behavior (Frick, Kaiser & Wilson, 2004). These types of studies that focus on different ways to consider knowledge, show some of the complexity of knowledge, and, provide some

insight into possible reasons why moving people toward desired behaviors can be difficult. One example Frick, Kaiser and Wilson (2004) offer regarding the knowledge to behavior relationship is that, “if people know that CO₂ contributes to global warming, they may still not know what actions they can take to reduce their CO₂ emissions” (p. 1599). Coyle (2005) adds to the case regarding the complexity of knowledge by explaining that,

While the simplest forms of environmental knowledge are widespread, public comprehension of more complex environmental subjects is very limited. The average American adult, regardless of age, income, or level of education, mostly fails to grasp essential aspects of environmental science, important cause/effect relationships, or even basic concepts such as runoff pollution, power generation and fuel use, or water flow patterns (p. ix).

The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior (Murphy & Olson, 2008) survey included 13 environmental knowledge questions. Fact-based questions were asked to “determine what participants actually know about the environment” (p.3). Individual knowledge scores from 1,000 Minnesota adults were compiled, and compared with their demographic data, to consider relationships.

Environmental Attitudes

A concept of attitudes as an evaluation, identifying topics and issues as, “good-bad, harmful-beneficial, pleasant-unpleasant, and likable-dislikable” (Ajzen, 2001, p. 28), aligns with research on adult citizens’ and their general attitudes relating to the

environment, or to pro-environmental behavior (Blake, 2001; Daniels & Brown, 1991; Diekmann & Preisendorfer, 1998a; Diekmann & Preisendorfer, 2003; Franzen, 2003; Hines, Hungerford & Tomera, 1986/87; Ignatow, 2006; Scott & Willits, 1994; Spash, 1997; Survey tests UK's environmental attitudes, 1998; Theobald, 2004; Weaver, 2002). These studies indicate that citizens are concerned about their local, national, and in some cases, global environmental issues, and, that they have varying degrees of positive and negative attitudes and concerns about specific topics and issues asked during surveys. Hines, Hungerford and Tomera's (1986/87) meta-analysis investigating the relationship between environmental attitudes and environmental behavior identified a moderate positive relationship ($r=.38$) between attitudes toward the environment and environmental action (behavior). Citizens' and their concerns about, or concerns for, the environment have also been identified in literature as environmental attitudes (Dunlap & Jones, 2002; Fransson & Gärling, 1999).

Environmental attitudes in the Minnesota reports on environmental literacy (Murphy, 2002, 2004) are identified as the adults' attitudes toward the environment and what they believe about certain environmental issues. Attitudes toward laws and regulations, environmental responsibility, and environmental education were considered in the first *Minnesota Report Card on Environmental Literacy* (Murphy, 2002). Attitudes toward environmental protection, who should be responsible for solving environmental problems, and attitudes toward Minnesota water quality were studied in the second report (Murphy, 2004). Attitudes toward environmental laws and regulations were considered in the third report (Murphy & Olson, 2008).

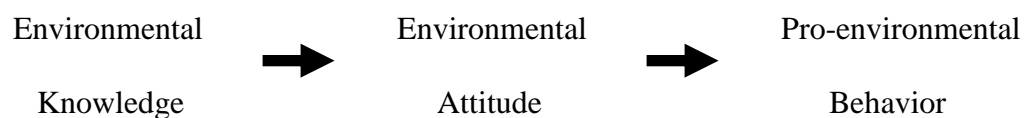
Many studies regarding attitudes focus on factors that may influence an adult's positive, negative, or neutral attitude toward environmental topics or issues. These studies often include possible relationships between attitudes toward the environment and interventions such as environmental education, or, attitudes and a person's gender, background, religion, ethnicity, or education (Benton, 1994; Bögeholz, 2006; Bonneau, 2003; Bord & O'Connor, 1997; Engel & Potschke, 1998; Ewert, Place, & Sibthorp, 2005; Franzen, 2003; Hodgkinson, & Innes, 2001; Hughes & Saunders, 2005; Hunter, 2000; Kennedy, Hyde & Karney, 2002; Kilbourne, Beckmann, Lewis, & Dam, 2001; Murphy, 2002; Murphy, 2004; National Environmental Education & Training Foundation, 2001; Synodinos, 1990; Tarrant & Green, 1999; Tarrant & Cordell, 1997; Won Hee Lee & Moscardo, 2005). One example is Franzen's (2003) study that compared citizen's attitudes of the natural environment from survey data collected from 26 countries. This data revealed that people who live in wealthier countries indicate greater concern for the environment than those who live in poorer countries. Another example is, Tarrant and Green's (1999) study where they examined relationships between outdoor recreation participation and environmental attitudes of adults. Their research indicated that increased knowledge positively correlated with positive attitudes toward the environment, and when combined with outdoor recreation and its outdoor experience, participants self-reported more pro-environmental behaviors. Other studies have found positive correlations between environmental attitudes and environmental behaviors (Chan, 2001; Fraj-Andrés & Martínez-Salinas, 2007; Kaiser, Ranney, Hartig & Bowler, 1999). Fraj-Andrés and Martínez-Salinas' (2007) study on ecological consumer behavior for

example, showed “environmental attitudes have a significant effect on ecological behavior and that the level of environmental knowledge moderates this relationship” (p. 74). Based on these studies indicating that demographic variables impact attitudes for certain environmental topics and issues, and, that attitudes appear to impact pro-environmental behaviors, these relationships will be studied here to further environmental literacy research efforts. *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) survey included six environmental attitude questions relating to existing environmental laws and regulations.

Environmental Behaviors

A previous review of environmental education literature by Kollmuss and Agyeman (2002) found that the following framework was considered ineffective for what shapes pro-environmental behavior:

Figure 2: Environmental KAB Framework



Their literature review found little evidence to support the assumption that increased environmental knowledge necessarily leads to increased pro-environmental behavior. Coyle’s (2005) discussion regarding this framework however indicates that the potential of the KAB framework is dependent on how environmental knowledge is defined, and, if considered more broadly it could represent the relationships between KABs better. For

example, if one assumes that increased environmental knowledge merely implies that the learner has more information on an environmental topic or issue, then information/knowledge as a factor does not appear to be a strong influence on behavior. However, if knowledge is conceived of as representing improved comprehension, such as learners' "understanding important causal relationships... what might cause air and water pollution, the ramifications of recycling, and what contributes to species loss" (Coyle, 2005, p. 34), then the relationship with pro-environmental decision making or pro-environmental problem solving improves. It stands to reason that a lack of accurate information regarding the environment, and its various issues, conversely diminishes the probability of informed decision making and problem solving. If, as Coyle (2005) mentions, environmental problems caused by individuals are indeed on the rise, then there is a need for citizens to be able to understand what is needed, and to be able to individually respond in pro-environmental ways.

As mentioned previously, underlying environmental education efforts is the encouragement of pro-environmental behaviors (Courtenay-Hall & Rogers, 2002; Culen, 1998; Holsman, 2001; Hungerford, Peyton & Wilke, 1980; Jensen, 2002; Kollmuss & Agyeman, 2002). Kollmuss and Agyeman (2002) define pro-environmental behavior as "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (p. 240). Courtenay-Hall and Rogers (2002), and Jensen (2002) add that non-conscious acts such as automatically putting glass bottles or aluminum cans into recycling bins, and indirect actions such as donating to environmental causes should also be considered as part of pro-environmental behavior. Environmental behaviors in the

Minnesota reports on environmental literacy (2002, 2004) are identified as the adults' self-reported behaviors (daily and longer term) related to the environment.

Over thirty-five years ago Maloney and Ward (1973) highlighted the need for human behavior change. Regarding ameliorating increasing ecological issues they posited that:

The solution to such a problem does not lie in traditional technological approaches but rather in the alteration of human behavior. In short, the ecological crisis is a crisis of maladaptive behavior... Ultimately, the solution lies with the sciences that deal with changing human behavior (Maloney & Ward, 1973, p. 583).

Maloney and Ward (1973) then developed an ecology scale meant to begin clarifying what the "population 'knows' regarding ecology, the environment, and pollution; how they feel about it; what commitments they are willing to make; and what commitments they do make" (p. 584). Their recommendation then, based on data indicating participants had a high degree of verbal commitment and affect, but lower levels of commitment and knowledge, was a need to focus on the changing of human behavior. Hallin (1995) put forward that behavior change is a complex process and that "instead of formulating a general model for behavioral change, it would be more fruitful to investigate specific types of behavioral change" (p. 574). To better support behavior change efforts, many researchers have considered various factors that influence pro-environmental behaviors. These include research on influences such as socioeconomics, demographics, mass communication efforts, environmental attitudes, tailored versus non-tailored messages for

an organization, low-cost hypothesis, knowledge, educational campaigns, native versus foreign born adults living in the United States, environmental beliefs, values, economy-environment trade-offs, environmental ethics, formative life experiences, verbal commitment, age, locus of control, voluntary environmental behavior programs, government incentives, political attitudes, and environmental education interventions such as workshops or classes (Berger, 1997; Chan, 1998; Clark, 2005; Cottrell, 2003; Daamen, Staats, Wilke, & Engelen, 2001; Diekmann & Preisendörfer, 2003; Frick, Kaiser, & Wilson, 2004; Grodzinska-Jurczak, Tomal, Tarabula-Fiortak, Nieszporek, & Read, 2006; Holbert, Kwak & Shah, 2003; Hunter, 2000; Hwang, Kim, & Jeng, 2000; Jensen, 2002; Jurin & Fortner, 2002; Karp, 1996; Kollmuss & Agyeman, 2002; Korfiatis, Hovardas, & Pantis, 2004; Marcinkowski, 1998; McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995; Negra & Manning, 1997; Palmer & Suggate, 1996; Rivera, 2004; Rock & Aden, 1999; Shih-Jang Hsu, 2004; Tarrant & Cordell, 1997; Tarrant & Green, 1999; Won Hee Lee & Moscardo, 2005). Briefly highlighting some of the research on pro-environmental behaviors, Chan's (1998) study on mass media as an influence of pro-environmental behavior suggested that mass media efforts should be increased to further promote pro-environmental behaviors. A study on patterns of TV viewing in the United States and pro-environmental behaviors carried out by Holbert, Kwak and Shah (2003) indicated that "older, female, better educated, and non-African-American tend to adopt more pro-environmental behaviors" (p. 188). Hwang et al (2000) found that a person's intention to act, locus of control, and attitude are more important than their knowledge of environmental issues and personal responsibility, for enhancing responsible

environmental behavior. Also, while Kollmuss and Agyman's (2002) literature review found little evidence to support the assumption that increased environmental knowledge necessarily leads to increased pro-environmental behavior, Hornik and Cherian's (1995) meta-analysis of recycling behavior found that the strongest predictors of recycling behavior were the level of consumer knowledge of recycling programs or their awareness of the recycling programs. Costs and convenience of action have also been looked at with regard to pro-environmental behavior. Diekmann and Preisendörfer (2003) explain that it is the costs of behaviors that are a key variable for people behaving pro-environmentally. Their research found that pro-environmental behaviors were most likely to occur if an action was low-cost for the citizen in that it was easy to perform, convenient, and had low monetary costs. Hallin (1995) also found that convenience was a significant factor for Minnesota adults from a small town and their pro-environmental actions.

Based on the various and even conflicting findings, Culen (1998), while discussing researchers and their environmental behavior models, states that, "the developers, along with most of the previous researchers concur that even more research is needed to completely understand environmental behavior and the variables that appear to be associated with it" (p. 42). *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy and Olson, 2008) survey included 12 environmental behavior questions relating to what participants do or do not do in their daily lives. Some variables that could be considered low-cost according to the Diekmann and Preisendörfer (2003) standards were asked as part of the Murphy and Olson's (2008) survey. These included asking survey participants

how often they: recycle things such as newspapers, cans and glass; turn off lights and electrical appliances when not in use or when leaving the room; and purchase lamps, light-bulbs and appliances that are energy efficient.

Studies on Environmental Knowledge, Attitudes, or Behaviors and Age and Gender

Mannheim's (1952) theory of generations suggested that important historical events occurring at the adolescent and young adulthood phases of life can permanently impact a cohort throughout its existence. Dunlap and Van Liere (1980) considered this and related research impacting issues and generations to conclude that:

Mannheim's theory would lead us to expect that continued exposure to alarming information on environmental deterioration (via the new media, environmental education courses, etc.) has left an indelible imprint on many young people during the past decade, forming an ecology-minded generation whose commitment to environmental reform should not disappear as they move into adulthood (p. 183, parentheses information in the original).

This theory appears to have some grounding when considering the socio-historical context of people in America who were teenagers or older during significant environmental events such as: Rachel Carson's book being published (1962); the polluted Cuyahoga River repeatedly catching on fire (1969 incident was highlighted in Time magazine); the Love Canal neighborhood learning their homes and public school had been built on a toxic waste dump (late 1970s), and the Three Mile Island (1979) and Chernobyl (1986) nuclear disasters. Coyle's (2005) nationwide environmental KAB's study did find that participants who finished high school prior to 1970 did better on the

environmental knowledge questions when compared with students who graduated after 1990 (Coyle, 2005, p. 3). Hallin's (1995) study with Minnesota adults, considered environmental concern and environmental behavior in terms of generational categories such as: the Depression generation, children of the Depression generation, the Vietnam generation, role models, and gradual evolvers. Hallin's research indicated that participants in their mid to late twenties during the Great Depression or during the Second World War (children of the Depression generation) were more likely to lead a frugal lifestyle and also made significant efforts to reduce their waste (Hallin, 1995). Coyle (2005) and Hallin's (1995) research trends then indicate that older adults may have higher environmental knowledge and behaviors than other adult age groups. However, Dunlap and Van Liere's (1980) review of environmental concern research indicated, "the predominant finding has been that age is negatively correlated with environmental concern" (p. 183). This agrees with Hsu and Roth's findings (1996) of community leaders in Taiwan where the younger community leaders scored higher on environmental knowledge and environmental attitudes.

Relationships between gender and environmental KABs vary in the literature. Coyle (2005) found that women "typically express a more positive attitude toward the environment than men" (p. 81). Bord and O'Connor's (1997) research on the gender gap in environmental attitudes indicated that women show more concern than men regarding environmental risk. However, Kaplowitz and Levine's (2005) study found that "the overall pattern suggests that sex is not substantially associated with environmental concern" (p. 191), but add that their conclusions are based on limited evidence. Hines'

(1987) data indicated that women self-report more pro-environmental behaviors than men. Zelezny, Chua and Aldrich's (2000) review of a decade of research on gender differences in environmental attitudes and behaviors found that "women report stronger environmental attitudes and behaviors than men" (p. 443). This pattern of females reporting stronger environmental attitudes and environmental behaviors than men remained consistent across age and 14 countries. Other studies indicate that males have significantly higher environmental knowledge scores than females (Arcury & Christianson, 1993; Coyle, 2005; Kibert, 2000; Murphy, 2002; Murphy 2004; SKEKAB, 2004; White, 2006). However, McDaniel and Alley (2005), when researching rural, urban, and developing watersheds in western Georgia, found that local environmental knowledge scores for females and males did not significantly differ.

Studies on Environmental Knowledge, Attitudes or Behaviors and Education and Income

With regard to environmental knowledge, research indicates that higher levels of education achieved offer an advantage in respondent environmental knowledge scores (Kaplowitz & Levine, 2005; National Environmental Education & Training Foundation, 2001; Nerbonne & Schreiber, *Connecting Knowledge, Attitudes and Behaviors*, 2005; SKEKAB, 2004). Education levels did explain over 11% of the variance in environmental knowledge in the Hsu and Roth (1996) study of community leaders in Taiwan, and was considered the best predictor of environmental knowledge and attitudes. Arcury and Christianson's (1993) research indicated that participants' income was positively related to global environmental knowledge. McDaniel and Alley (2005), from their study on land use practices in western Georgia, found that there was not a strong

relationship between local environmental knowledge scores and participants' education or income levels. Seemingly in answer to some of the conflicting findings, Kaplowitz and Levine (2005) found that "associations between income and environmental concern are quite ambiguous and fail to support the hypothesized positive association (p. 190). Similarly, a survey for considering the environmental knowledge, attitudes, and behaviors of Kentucky adults, indicated that attitudes about the environment were not significantly different among the various educational levels (SKEKAB, 2004).

Cottrell's (2007) study of socio-demographics and environmental attitudes among recreational boaters in Maryland found that "as income, age and education increase, environmental concern decreases" (p. 364). Education and income do appear to impact environmental behavior for some groups. For instance, Mancl, Carr and Marrone's (2003) study of knowledge of ecological principles of Ohio's adults found that their lowest literacy group (most often the less educated, below the median household income, older, female and minority) tend to not engage in outdoor activities, or access environmental groups for learning. Most from the lowest literacy group from the study also identified that they learn from television. Hines, Hungerford and Tomera's (1987) meta-analysis of research on responsible environmental behavior indicated that there is a weak positive relationship between both income and environmental behavior, and, education level and environmental behavior.

One area this secondary data analysis study will address is the questionnaire scores on the Murphy and Olson (2008) report and the combined demographical variables of age (categorized into generations), gender, education, and income. This will be for the

purpose of further considering how generations, gender, education and income from the Murphy and Olson (2008) study correlated with their environmental knowledge, attitude and behavior scores. This information can be used to consider other research that analyzes the relationships between wealth and a person's environmental knowledge or attitude. These combined relationships were not analyzed as part of the Minnesota report or similar national reports.

Studies on Environmental Knowledge, Attitudes or Behaviors and Non-formal and Informal Environmental Education and Learning

It can be assumed that learners who are interested in the environment or environmental issues will seek out information beyond formal education venues. Non-formal environmental education and informal environmental education are options for citizens to gain more information on the environment. Non-formal education refers to, “organized activities outside educational institutions, such as those found in learning networks, churches, and voluntary associations” (Merriam & Caffarella, 1999, p. 25). This type of learning can be compared to question 25 on *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) survey asking respondents how much environmental education they get from: government agencies (state or Federal); conservation or environmental groups; environmental learning centers, including nature centers, parks, science museums, and zoos; and scientific experts. Informal education or learning refers to “the experiences of everyday living from which we learn something” (Merriam & Caffarella, 1999, p. 25). This can be compared to question 24 on *The Third*

Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior (Murphy & Olson, 2008) survey asking respondents how much environmental education they get from: the internet, newspapers, magazines, television, radio and conversations with their children and friends to get environmental education. Volk and McBeth's (1998) white paper on environmental literacy in the United States showed that non-formal and informal learning venues were significant factors for instructional effectiveness of environmental instruction for adults. In most cases cited there was a positive effect between the non-formal and informal instruction and adults' environmental KABs. Yavetz, Goldman and Pe'er (2005) found, in their study of beginning students from three teacher-training colleges, that television and newspapers were identified as the leading sources for information on environmental issues. Mancl, Carr and Marrone (2003) found that their lowest literacy respondents were most likely to use informal learning, or television, to gain environmental information. Data from Coyle's (2005) report identified media as the leading source of environmental education, but, he comments that a potential issue with this is that, "although adults may have a more mature capacity to absorb and process the environmental information they receive, they generally do so without the guidance of thoughtful instructors" (p. 15). Clover (1997) adds her concerns regarding the need to thoughtfully consider various learning venues for adults, and posits:

There is still little attention paid around the world to environmental education for adults within their own communities - what we call non-formal learning. The focus tends to be on... programmes in pedagogical institutions, and particularly

for children. While this is extremely important, it is adults who make decisions that affect the biosphere every day.

Non-formal and informal education venues will be considered as part of this research to try to better gauge whether involvement in self-directed learning venues such as non-formal and informal education positively relate to environmental KABs.

Environmental Literacy

Environmental literacy can be defined as “possessing knowledge about the environment and issues related to it, and being capable of and inclined to further self-directed environmental learning and/or action” (North American Association for Environmental Education, 2004). This definition aligns well with past and current research efforts in the area of environmental KABs since this definition considers environmental literacy to include a person’s knowledge about the environment and related issues, as well as her or his inclination to further self-directed environmental learning and action (tied to their attitudes and pro-environmental behaviors). Roth (1991) offered a proficiency continuum of environmental literacy:

- Nominal Environmental Literacy--the ability to recognize many of the basic terms used in communicating about the environment and to provide a rough working definition of their meanings. Developmentally, the nominally environmentally literate person, although aware of the terms or vocabulary, has little or no depth of understanding of them, has only rudimentary process skills, and has no more than casual commitment to environmental concerns and actions.

- Functional Environmental Literacy--the capacity to use fundamental environmental knowledge, concepts, and thinking skills to formulate action positions on particular environmental issues and in daily behavior. The functionally literate person can communicate the substance of an account to a third party, either orally or in writing.
- Operational Environmental Literacy--the capacity to regularly perceive environmental issues; gather and evaluate pertinent information; examine and choose among alternatives; take positions and actions that work to sustain and develop the foundation of environmental knowledge; and use elements of questioning, analytical and deductive reasoning, logical thought processes, and objective analysis.

A quick review of the descriptions of nominal, functional and operational environmental literacy show that nominal literacy corresponds to having general environmental knowledge but lacking in depth of understanding that might lead to environmental concern or pro-environmental behavior. Functional literacy corresponds to having general knowledge and a rudimentary ability to take a position (have an attitude about a particular issue) but not necessarily acting upon a position. Operational environmental literacy then corresponds to the positive alignment of environmental knowledge, attitudes and behaviors. Considering the KAB scores from Murphy and Olson's (2008) report and Roth's (1991) environmental literacy continuum can help determine the general range of where Minnesota adults are at in terms of environmental literacy.

Unfortunately the research to date is not overly encouraging regarding adults' environmental literacy at either the national or state level. For instance, *Environmental Literacy in America: What Ten Years of NEETF/Roper Research and Related Studies say About Environmental Literacy in the U.S.* (Coyle, 2005) indicates what Americans' general knowledge base was about popular environmental topics that occurred in the media (and were assumed the average citizen would therefore be familiar with) within the past year the research studies were undertaken. Coyle (2005) explains:

Our years of Roper data show a steady pattern of environmental ignorance even among the most educated and influential members of society... With most environmental issues becoming more complex and difficult to manage... today's experts are less well positioned to address tomorrow's environmental needs without a lot more help from the general public. A stronger public understanding of environmental science and related issues is a growing necessity (p. 6).

There are several studies that focus on relationships between environmental knowledge, attitudes, and behaviors (Franzen, 2003; Holden, 1995; Murphy, 2002; Murphy, 2004; Murphy & Olson, 2008; National Environmental Education & Training Foundation, 1997; Environmental Education & Training Foundation, 1998; Environmental Education & Training Foundation, 2001; Pennsylvania Center for Environmental Education, 2001; Scott & Willits, 1994; White, 2006). These comprehensive studies consider many of the general factors mentioned above under environmental attitudes, behaviors and knowledge. Usually the research in the area which combines environmental KABs is surveying and testing about very general environmental knowledge, attitudes, and

behaviors, leaving much work to be done to consider adults in more local contexts such as states, universities and colleges, and public officials for example.

Summary

Relationships between environmental knowledge, attitudes, and-or behaviors and age, education, income, and gender have been considered in various capacities in environmental education literature. However, relatively few of these research studies focus on general adult populations. Few also consider generations and possible relationships with environmental KABs. Finally, no studies were found that considered respondents' participation in non-formal and informal environmental learning and the possible relationships of these with environmental knowledge, attitudes, and behaviors.

CHAPTER 3 – RESEARCH METHOD

The purpose of this research is to indentify demographic, non-formal, and informal learning factors that correlate with Minnesota adults' environmental literacy. This secondary data research study will analyze the survey and demographic data from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) to explore environmental literacy as indicated by KAB scores. This research will be accomplished using a correlational research design to study the relationship between multiple variables (Fanslow, 1989; McMillan, 2000) and using secondary data analysis to consider factors previously not examined from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy and Olson, 2008). The method used to analyze the environmental literacy data is multiple regression. The independent variables for this study are demographics and learning, and the three dependent variables that will be considered in this study are environmental knowledge, attitudes, and behaviors.

Murphy and Olson's (2008) study considered the basic knowledge of 1,000 Minnesota adults regarding the environment. The Minnesota report on adult environmental literacy was based on the National Environmental Education & Training Foundation (2001) national report. Some questions are identical on the Minnesota and national surveys. To align with the national study on adult environmental literacy, knowledge questions were chosen based on popular environmental topics and current issues that average citizens should be familiar with. *The Third Minnesota Report Card on*

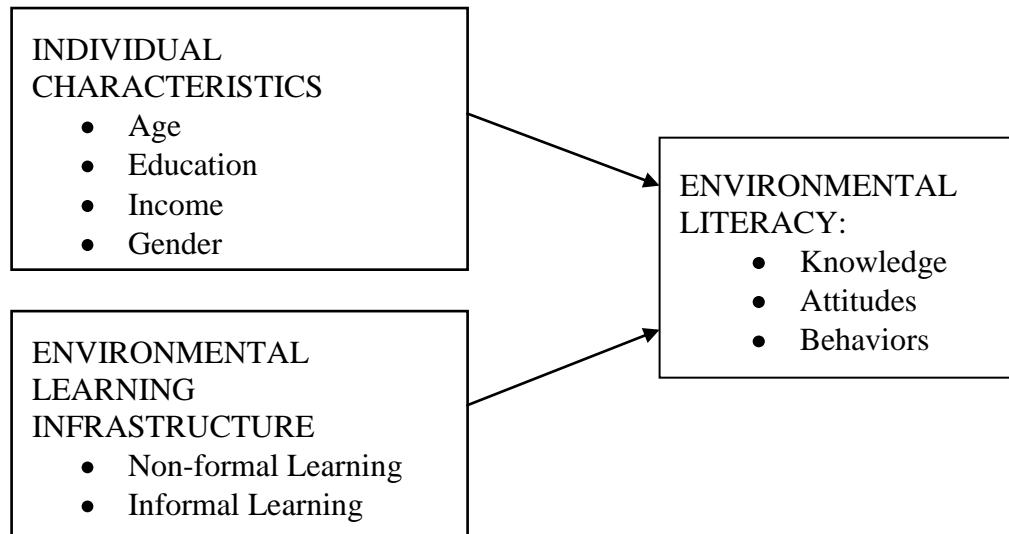
Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior (Murphy and Olson, 2008) also includes information on Minnesota adults' knowledge of global warming, and their attitudes toward environmental protection and responsibility. The report includes demographic information such as gender, age, race, geographic distribution, household income, and educational attainment. The Minnesota report does not include analysis on how generation, income, education level, gender, and non-formal or informal learning, predict environmental knowledge, attitude and behavior scores (KABs were each looked at separately).

The next section contains a conceptual overview of influences of an adult's environmental knowledge, attitudes, and behaviors which will be considered as part of the secondary data analysis. These influences are age, education, income, gender, and non-formal, and informal environmental education. As previous studies have indicated, age, education, income and gender can help predict environmental knowledge, attitudes, and behaviors to varying degrees. With this in mind, the following conceptual overview is proposed to consider these relationships among the variables from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008).

Conceptual Overview

Research question: *What is the influence of demographics, and non-formal and informal learning on Minnesota adults' environmental KABs?*

Figure 3 Influences on Environmental Literacy



Survey Design

Survey questions for the Murphy and Olson (2008) report came either directly, or were adapted, from:

- Various National Environmental Education Training Foundation/Roper Starch Worldwide Surveys
- The First Pennsylvania Environmental Readiness for the 21st Century Survey
- Previous surveys on adult environmental literacy in Minnesota

Survey questions were also developed specifically for this survey with members of a working group (see Murphy & Olson's, 2008, report)

The survey contained four parts (see Appendix B for full survey).

Knowledge – Section 1

Section 1, combines the self-report knowledge questions, factual knowledge related questions, and how participants identify they get their environmental information. The self-report knowledge questions were not analyzed for this research study.

For the self-report knowledge questions participants were asked gauge their knowledge on these environmental topics, and environmental laws and regulations, using a five-point scale (1 point means a lot, 5 points means nothing at all): environmental problems, air pollution, energy issues, water quality, global warming.

For the factual knowledge related questions, participants were asked 13 fact-based questions relating to pollution, global warming, animal extinction, wetlands, garbage, energy, and nuclear waste disposal. To align with the national study on adult environmental literacy, knowledge questions were chosen based on popular environmental topics and current issues that average citizens should be familiar with. Respondents had the option of selecting from four possible answers with only one being correct, and respondents could also say that they did not know the answer. Correct responses were assigned a score of one, and incorrect responses a score of zero. The lowest aggregate score for a participant's knowledge was one and the highest 12.

For the self-reported environmental learning questions (two questions with multiple options) respondents were asked to gauge, using a five-point scale (1 means use a lot, 5 means do not use at all), how much “you use each of the following ways to get environmental information”: internet; newspapers – hard copy or online; magazines –

hard copy or online; television; radio; conversations with friends or neighbors; and conversations with children about their environmental learning experiences. Aggregate scores for this question will be referred to as informal environmental learning scores. Respondents were also asked to gauge, using a five-point scale (1 means get a lot, 5 means get none at all), “how much environmental information you get” from: government agencies (state or Federal); conservation or environmental groups; environmental learning centers including nature centers, parks, science museums, and zoos; and scientific experts. Aggregate scores for this question will be referred to as non-formal environmental learning scores. Responses for the non-formal and informal learning questions were recoded to 1 means do not use at all, and 5 means use a lot, for analysis purposes. The higher the aggregate score on informal and non-formal learning, the more actively engaged the participants are in self-directed environmental learning. Scores ranged from 7 to 37 for informal learning, and 4 to 22 for non-formal learning. Participants were also asked if there are other sources from which they got environmental information. If they answered yes they were asked to list any other sources.

Attitudes – Section 2

Section 2, the attitudes’ section, contains six questions. Participants were asked to state whether they thought certain laws and regulations have gone too far, not far enough, or have struck about the right balance pertaining to these areas: air pollution, water pollution, chemicals in your food, land development, energy conservation, and energy efficiency and global warming. Responses for the environmental attitudes’ questions were recoded to: 1 means the environmental laws and regulations have gone too far,

2 means struck the right balance, and 3 means environmental laws and regulations have not gone far enough. Participants' attitude scores ranged from 6 to 18. It is perceived that participants with higher aggregate scores on the attitude questions have greater concern that current environmental laws and regulations are insufficient.

Behaviors – Section 3

Section 3, the behaviors' section, includes twelve questions. Participants were asked to identify how often they do each of the following (1 means almost always do it, 5 means never do it): recycle things such as newspapers, cans and glass; turn off lights and electrical appliances when not in use or when you leave the room; bike or walk to work; use the bus; carpool with others; purchased lamps, light bulbs, and appliances that are energy efficient; run air conditioner less often in the summer; lower the thermostat in the winter; accelerate slowly when driving; donate money annually to an environmental group or organization; buy organic foods on a regular basis; and buy locally-grown foods on a regular basis. Responses for the behavior questions were recoded to 1 means never do it and 5 means almost always do it, for analysis purposes. After recoding, these scores ranged from 15 to 56. The higher the aggregate score on the behavior questions, the more actively engaged the participant is in environmentally friendly behaviors. If participants mention that they donate money annually to an environmental group they were asked an additional question regarding how much they annually donate.

Demographics – Section 4

Section 4, the demographics' section, contains seven items and gathered this personal information: age (recorded what year the participant identified she or he was

born in), highest level of education completed, income before taxes, gender, Minnesota county of residence, racial or ethnic group, and how many hours per week respondent spends outside each week not including the time spent for her or his employment.

Evidence of validity and reliability of survey

Content and face validity were determined by a working group of 17 members (see the Murphy and Olson, 2008, report for working group members and affiliations). From an email with *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) principle investigator, Dr. Anthony Murphy (March 26, 2009):

Many of the questions from the national survey had already been tested for reliability and validity (see Coyle's information below). For the questions that we developed specifically for this survey (See Appendix B for the full list of questions.), we worked with a working group of 17 of people. Then, with Marketline Research, the questions were tested for reliability and validity in a number of pilot phone interviews before they were used with the general public. Minor changes were made to the questions based on the pilot phone interviews and they were tested a second time with a small group before they were used with the general public.

The complete methodology information as listed in the Murphy and Olson (2008) report is available in Appendix C. For questions from the national study of adult environmental literacy, Coyle's (2005) information on their survey's reliability and validity is also included (p. 2):

Social scientist and educator Lynn Musser designed our first quiz. She selected question subjects that the public was likely to have heard about through the media, and pre-tested more than 50 such questions with focus groups to screen out confusion and bias. For the 1997 survey, 12 questions were crafted to reflect a profile of basic environmental knowledge (see Appendix B for the full list of questions.) Each question was shaped into a multiple choice format with one correct answer, one plausible but incorrect answer, and two non-plausible answers. Dr. Musser counseled us on the need to aim the questions at the average intelligent adult and to avoid using an insider's familiarity with the subject matter.

The reliability estimate of each subscale of *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) was calculated using SPSS and Cronbach's alpha reliability analysis. This was to estimate the internal consistency of the items for the survey data. A reliability coefficient of .70 or higher is desirable. The 13 item knowledge subscale alpha coefficient was .73. The alpha coefficient for the six item attitude's subscale was .79, and the 12 item behavior's subscale alpha was .62. Therefore, most of the measures for the variables being investigated had acceptable reliability estimates except one, adult's behavior concerning environment, which showed slight low reliability. It is recognized that behaviors are difficult to measure (Gilbert, Fiske & Lindzey, 1998; Hsu, 1996), and thus less likely to have high internal consistency.

Population and Sample

Target population: Minnesota adults

Accessible population: a sample of Minnesota adults

Sample described

- n = 1,000 Minnesota Adults (18 years and older)
- Gender
 - Female – 577 survey participants or 57.7% (can compare this to Minnesota 2000 Census population data – females age 18 and older 1,857,185 which is 51% of the adult population).
 - Male – 423 survey participants or 42.3% (can compare this to Minnesota 2000 Census population data – males age 18 and older 1,775,400 which is 49% of the adult population).
- Age of respondents
 - Range - participants ranged in age at the date of the survey (November 2007) from 18 years old to 97 years old
 - Mean – average age of the survey participants was 54 years old

Data Set

For the complete methodology information as listed in the Murphy and Olson (2008) report see Appendix C. Sections from the Murphy and Olson report regarding the data set are included here:

The survey for the Third Minnesota Report Card on Environmental Literacy was carried out by MarketLine Research between August 24, 2007 and November 6,

2007. MarketLine Research used a random-digit dial sample. Random-digit dialing ensures an equal probability of selection for all residential telephone numbers within a specified location. MarketLine researchers also randomized selection within the household to further equalize selection probabilities. For this survey, randomization within the household was attained by asking to speak to the adult with the most recent birthday.

The survey data was collected by MarketLine interviewers using computer-aided telephone interviewing (CATI) system, which assisted in the consistency of interview protocol. The data that was collected was knowledge, attitudes and behaviors in relation to the environment, as well as demographic data of the respondents. One thousand interviews were completed with adults throughout Minnesota with an estimated interview time of 15 minutes per session.

Data Analysis

The research design of the present study is a secondary data analysis using correlational techniques and regression modeling to account for adult learners' environmental knowledge, attitudes, and behaviors, as well as these dependent variables in relation to certain demographic variables, and participants self-reported use of informal and non-formal learning options. All statistical procedures were conducted using SPSS (version 17). Descriptive statistics will be used to summarize the survey responses. Data from the survey were analyzed using analysis of variance (ANOVA), t-tests and multiple regression. Specific analysis will be discussed next.

Data Analysis for Environmental Knowledge, Attitudes and Behaviors

One-way ANOVA was used for the following research questions to analyze the extent to which the groups vary from one another with respect to the question's dependent variable. The dependent variables knowledge, attitudes, and behaviors were looked at separately for each question. If the difference in means was significant ($p < .05$), a post hoc Bonferroni test was conducted.

Question 1: *What is the relationship between an individual's age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), and their KAB scores?*

Question 2: *What is the relationship between an individual's level of education and their KAB scores?*

Question 3: *What is the relationship between adults' income levels and their KAB scores?*

T-tests were used to compare mean scores for females and males for the following question:

Question 4: *What is the relationship between gender and KAB scores?*

Multiple regression was conducted for the following questions to consider if any statistically significant correlations existed between the dependent measures, a set of predictor variables, and non-formal and informal learning participation. Specifically, multiple regression was conducted to test whether adding informal and non-formal learning participation to the other independent variables of age, education levels, gender,

and income, further contributed to the predictive ability for knowledge, attitudes, and behavior scores (each looked at separately).

Question 5: How well do age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), education levels, gender, income, and adults' participation in non-formal learning predict KAB scores (each looked at separately)? How much variance in the KAB scores can be explained by these independent variables?

Question 6: How well do age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), education levels, gender, income, and adults' participation in informal learning predict KAB scores (each looked at separately)? How much variance in the KAB scores can be explained by these independent variables?

Summary

This chapter provided a brief outline of the survey instrument, collection procedure, coding changes, and methods used to address the research questions. A questionnaire was used to collect the data for this study. One thousand surveys with Minnesota adults were completed between August and November 2007. Chapter four provides the results for this study.

CHAPTER 4: RESULTS

Introduction

The purpose of this research is to consider the environmental literacy, or, the environmental knowledge, attitudes, and behaviors, of adults in Minnesota and possible factors that influence environmental literacy. Specifically this research will: (1) measure the environmental literacy of Minnesota adults, (2) explore possible relationships between Minnesota adults' environmental literacy variables and their demographic, non-formal and informal learning data, and (3) determine the relative contribution of demographic and learning variables for predicting positive environmental behavior. The research will be accomplished by conducting a secondary data analysis to consider the first three aspects mentioned. This secondary data research study will analyze the survey and demographic data from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008) to explore what factors might positively and negatively influence environmental understanding, and pro-environmental behavior as indicated by KAB scores. The research questions were tested and the survey data analyzed using SPSS (version 17). Correlation analysis was performed to determine relationships between each of the independent variables and adult environmental KABs. Multiple regression analysis was used to predict knowledge, attitude and behavior scores from the demographic, and learning variables, as well as to ascertain the amount of variance in KABs that could be attributed to the demographic, and learning predictor variables. Before running statistical

analysis preliminary checks were conducted to ensure that there was no violation of the assumptions of normality and homogeneity of variances.

This chapter will begin by providing descriptive statistics to identify the individual variables in the study. The study's research questions will then be considered individually to guide the presentation of the data.

Profile of the Respondents

Gender and Age

As shown in table 1, the respondents were represented by 577 females (57.7%) and 423 males (42.3%). The largest portion of the respondents after categorizing age into generation categories was 41.3% in the 43-61 range, followed by 31.8% in the 62-97 range, then by 20.9% in the 29-42, and finally by 6% in the 18-28 range. The average age of survey participants was 54 years old.

Table 1

Frequencies and Percentages for Gender and Age of Respondents

Demographic	Category	<i>f</i>	%
Gender	Females	577	57.7
	Males	423	42.3
Age	28 or less	59	6.0
	29-42	207	20.9
	43-61	408	41.3
	62 or over	315	31.9
	Missing	11	1.1

Highest level of education and Income levels

Table 2 shows the distribution of the respondents' education levels and income levels.

There was a fairly even split between respondents who had at reported they had at least a two year college degree (54%), and the respondents who reported having only some college or less (46%). For income, the largest proportion of respondents (22.8%) reported an income level of greater than \$50,000 to \$75,000, followed closely by 21.7% of respondents reporting an income of greater than \$30,000 to \$50,000, then by 16.6% in the over \$100,000 range, and 15.7% in the greater than \$15,000 to \$30,000 range, 14.2% reported an income greater than \$75,000 to \$100,000, and finally 6.9% reported an income of \$15,000 or less.

Table 2

Frequencies and Percents for Highest level of education and Income levels

Demographic	Category	<i>f</i>	%
Highest level of Education completed*	High school graduate/GED or less	252	25.2
	Some college	207	20.7
	2 year degree	129	12.9
	4 year degree	245	24.5
	Graduate degree	166	16.6
Income levels*	\$15,000 or less	62	6.9
	Greater than \$15,000 to \$30,000	141	15.7
	Greater than \$30,000 to \$50,000	195	21.7
	Greater than \$50,000 to \$75,000	205	22.8
	Greater than \$75,000 to \$100,000	128	14.2
	Over \$100,000	169	16.6

*missing cases were excluded

Correlation Analysis

To measure the environmental literacy of Minnesota adults each variable in the study was independently tested for correlation with the dependant variables of environmental knowledge, attitudes, and behaviors separately (see Table 3). This analysis is provided to determine if the independent variables did have an impact on environmental knowledge, attitudes, and behaviors, as well as to provide information regarding how the study variables related to each other. As a guideline, a correlation coefficient of .10 represents a small positive relationship, .30 represents a medium positive relationship and .50 represents a large positive relationship (Pallant, 2007).

Each variable in the study was independently tested for correlation with knowledge scores. Environmental knowledge scores were weakly positively correlated, and statistically significant, with education, income, and informal and non-formal environmental learning participation. Environmental attitude scores were weakly positively correlated, and statistically significant, with education, and informal and non-formal environmental learning participation. Environmental behavior scores were weakly positively correlated, and statistically significant, with education, income, and informal and non-formal environmental learning participation.

Table 3

Correlation of Study Variables to Adult Environmental KABs

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8
1. Gender										
2. Education Level			-.090**							
3. Generation from year born			.020	-.161**						
4. Income Level			-.191**	.461**	-.206**					
5. Informal learning	19.55	4.71	-.043	.109**	-.099**	.125**				
6. Non-formal learning	10.34	3.82	-.108**	.286**	-.070*	.243**	.476**			
7. Knowledge	6.18	2.56	-.328**	.291**	.049	.287**	.242**	.325**		
8. Attitude	14.54	2.89	.103**	.088**	.020	.002	.185**	.145**	.145**	
9. Behavior	36.10	6.45	.086**	.164**	-.013	.144**	.396**	.348**	.178**	.267**

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

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

One-way ANOVA was used for the first three research questions to analyze the extent to which the groups vary from one another with respect to the question's dependent variable. The dependent variables environmental knowledge, attitudes, and behaviors, were looked at separately for each question. Normality was assumed for each of the variables. In addition, the Levene's test of homogeneity was examined for significance. If the difference in means was significant ($p < .05$) for ANOVA, a post hoc Bonferroni test was conducted. This test indicated which group means were statistically different from one another.

Assuming a positive relationship between each of the dependent variables (environmental knowledge, attitude, and behavior scores), and the independent variables of age, education levels, and income levels, the statistics do indicate a weak positive relationship or as age, education and income levels increase so do knowledge, attitude and behavior scores. Comparing these relationships by groups further identifies and clarifies how age, education, and income groups relate to the environmental knowledge, attitude, and behavior scores.

Question 1: *What is the relationship between an individual's generation (age range) and their environmental KAB scores?*

One-way between groups ANOVA was conducted to explore the impact of age on environmental knowledge, attitudes, and behavior scores. Subjects were divided into four groups according to their age (Group 1/Generation Y: 28yrs or less; Group 2/Generation X: 29 to 42yrs; Group 3/Baby Boomers: 43-61yrs; Group 4/Silent Generation: 62yrs or

older) (age groups based on Smith & Clurman, 1997 & 2007). There was a statistically significant difference at the $p < .05$ level between the age groups for only the environmental knowledge and behavior scores (See Table 4). No further analysis was completed on the effect of age and environmental attitudes because it did not have a significant ANOVA result.

Table 4

Summary of Age Groups and KAB's Analysis of Variance (ANOVA) Results

Variable	Sum of Squares	df	Mean Square	F	p
Knowledge					
Between Groups	126.89	3	42.30	6.53	.00**
Within Groups	6,338.98	978	6.48		
Total	6,465.87	981			
Attitudes					
Between Groups	56.50	3	18.84	2.24	.08
Within Groups	8,146.32	968	8.42		
Total	8,202.82	971			
Behaviors					
Between Groups	1,681.84	3	560.61	14.10	.00**
Within Groups	39,174.52	985	39.77		
Total	40,856.37	988			

** $p < 0.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental knowledge and ages, only one age group, Generation Y's, mean knowledge score (M=5.05, SD=2.31) was significantly different (lower) from each of the other three generations' mean environmental knowledge scores (see Table 5). While the Baby Boomer generation had the highest mean knowledge score of the age groups, Baby Boomer (M=6.50, SD=2.51), Generation X (M=6.07, SD=2.57), and Silent Generation's (M=6.03, SD=2.62) mean knowledge scores did not differ significantly from each other.

Table 5

Bonferroni Comparison for Age Groups and Environmental Knowledge

Variable	Mean Knowledge Score Difference	Std. Error	<i>p</i>	95% CI	
				Lower Bound	Upper Bound
Baby Boomers vs.					
Generation Y	1.45*	.35	.00	.51	2.39
Generation X	.43	.22	.30	-.15	1.01
Silent Generation	.47	.19	.08	-.03	.98
Generation X vs.					
Generation Y	1.02*	.38	.04	.03	2.02
Silent Generation	.04	.23	1.0	-.56	.65
Silent Generation vs.					
Generation Y	.98*	.36	.04	.02	1.93

* $p < 0.05$

There was no statistically significant difference at the $p < .05$ level between the generation groups and attitude scores. The mean score for the Baby Boomer generation however was slightly higher than the other three generation groups (see Table 6).

Table 6

Environmental Attitude means and standard deviations for age groups

Variable	Environmental Attitudes
Generation Y: 1979-2000	$M=13.68, SD=3.66$
Generation X: 1965-1978	$M=14.64, SD=2.78$
Baby Boomers: 1946-1964	$M=14.70, SD=2.83$
Silent Generation: 1900-1945	$M=14.45, SD=2.91$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and ages, only the Baby Boomer generation's mean behavior score (M=37.51, SD=6.29) was significantly different (higher) from each of the other three generations' mean behavior scores (see Table 7). Generation Y (M=33.69, SD=6.01) had the lowest mean behavior score of the age groups. Generation X (M=35.87, SD=5.98), Generation Y, and Silent Generation's mean behavior scores (M=34.82, SD=6.59) did not differ significantly from each other.

Table 7

Bonferroni Comparison for Age Groups and Environmental Behaviors

Variable	Mean Behavior Score Difference	Std. Error	<i>p</i>	95% CI	
				Lower Bound	Upper Bound
Baby Boomers vs.					
Generation Y	3.81*	.88	.00	1.49	6.14
Generation X	1.64*	.54	.02	.21	3.06
Silent Generation	2.69*	.47	.00	1.44	3.94
Generation X vs.					
Generation Y	2.18	.93	.12	-.28	4.64
Silent Generation	1.06	.56	.37	-.43	2.55
Silent Generation vs.					
Generation Y	1.12	.89	1.0	-1.24	3.49

**p* < 0.05

Question 2: *What is the relationship between an individual's level of education and their environmental KAB scores?*

One-way between groups analysis was conducted to explore the impact of education on knowledge, attitudes, and behavior scores. Subjects were divided into five groups according to their education levels (Group 1: High school grad, GED or less; Group 2: Some College; Group 3: Two-year degree; Group 4: Four-year degree; Group 5: Graduate degree). There was a statistically significant difference at the $p < .05$ level between these groups for their KAB scores (see Table 8).

Table 8

Summary of Education and KABs Analysis of Variance (ANOVA) Results

Variable	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>p</i>
Knowledge					
Between Groups	583.49	4	145.87	24.21	.00**
Within Groups	5,946.38	987	6.03		
Total	6,529.87	991			
Attitudes					
Between Groups	113.83	4	28.46	3.43	.01*
Within Groups	8,101.02	977	8.29		
Total	8,214.85	981			
Behaviors					
Between Groups	1,364.13	4	341.034	8.46	.00**
Within Groups	40,060.25	994	0.30		
Total	41,424.38	998			

* $p < 0.05$, ** $p < 0.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental knowledge and education, only Group 4 (Four-year degree) and Group 5 (Graduate degree) mean knowledge scores were significantly different (higher) from each of the other three groups' mean knowledge scores (see Table 9). Group 4 (M=6.86, SD=2.50) and Group 5's mean knowledge scores (M=7.32, SD=2.52) did not differ significantly from each other nor did Group 1 (M=5.26, SD=2.41), Group 2 (M=5.83, SD=2.33) or Group 3's (M=5.81, SD=2.56) mean environmental knowledge scores differ significantly from each other.

Table 9

Bonferroni Comparison for Education Levels and Environmental Knowledge

Variable	Mean Knowledge Score Difference	Std. Error	<i>p</i>	95% CI	
				Lower Bound	Upper Bound
Group 5 vs.					
Group 4	.46	.25	.66	-.24	1.15
Group 3	1.51*	.29	.00	.69	2.33
Group 2	1.49*	.26	.00	.77	2.21
Group 1	2.06*	.25	.00	1.37	2.75
Group 4 vs.					
Group 3	1.05*	.27	.00	.30	1.81
Group 2	1.04*	.23	.00	.39	1.69
Group 1	1.60*	.22	.00	.98	2.22
Group 3 vs.					
Group 2	-.02	.28	1.0	-.80	.80
Group 1	.55	.27	.42	-.09	1.21
Group 2 vs.					
Group 1	-.56	.23	.15	-1.21	.09

**p* < 0.05

Post-hoc comparisons using the Bonferonni test indicated that for environmental attitudes and education, Group 1 (High school grad, GED or less) and Group 5's (Graduate degree) mean attitude scores (see Table 10) were significantly different from each other. Group 1's mean score ($M=14.23$, $SD=2.65$) was lower than Group 5's ($M=15.23$, $SD=2.73$). Group 3 (Two-year degree) and Group 5's mean attitude scores were also significantly different from each other. Group 3's mean score ($M=14.26$, $SD=3.27$) was lower than Group 5's mean score. Group 2 ($M=14.61$, $SD=2.82$) and Group 4's ($M=14.54$, $SD=3.03$) mean environmental attitude scores did not differ significantly from any other education level group.

Table 10

Bonferroni Comparison for Education Levels and Environmental Attitudes

Variable	Mean Attitude Score Difference	Std. Error	<i>p</i>	95% CI	
				Lower Bound	Upper Bound
Group 5 vs.					
Group 4	.71	.29	.15	-.11	1.53
Group 3	.97*	.34	.04	.02	1.93
Group 2	.62	.30	.40	-.23	1.47
Group 1	1.00*	.29	.01	.19	1.82
Group 4 vs.					
Group 3	.27	.32	1.0	-.62	1.03
Group 2	-.09	.27	1.0	-.86	.68
Group 1	.30	.26	1.0	-.44	1.03
Group 3 vs.					
Group 2	-.35	.32	1.0	-1.3	.56
Group 1	.03	.31	1.0	-.85	.91
Group 2 vs.					
Group 1	.39	.27	1.0	-.38	1.15

* $p < 0.05$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and education, Group 1 (High school grad, GED or less), and the Group 4 (Four-year degree) and Group 5's (Graduate degree) mean behavior scores (see Table 11) were significantly different from each other. Group 1's mean behavior scores ($M=34.85$, $SD=6.74$) were lower than both Group 4 ($M=36.72$, $SD=6.32$) and Group 5's mean behavior scores ($M=38.20$, $SD=6.59$). Group 5's mean behavior scores were also significantly different (higher) from all groups except Group 4. Group 4 and Group 5's mean behavior scores however did not differ significantly from each other nor did Group 2 ($M=35.85$, $SD=5.60$) or Group 3's ($M=35.08$, $SD=6.44$) mean environmental behavior scores significantly differ.

Table 11

Bonferroni Comparison for Education Levels and Environmental Behaviors

Variable	Mean Behavior Score Difference	Std. Error	<i>p</i>	95% CI	
				Lower Bound	Upper Bound
Group 5 vs.					
Group 4	1.48	.64	.21	-.32	3.27
Group 3	3.11*	.75	.00	1.02	5.21
Group 2	2.35*	.66	.00	.49	4.21
Group 1	3.35*	.63	.00	1.56	5.13
Group 4 vs.					
Group 3	1.64	.69	.18	-.31	3.58
Group 2	.88	.60	1.0	-.81	2.56
Group 1	1.87*	.57	.01	.27	3.47
Group 3 vs.					
Group 2	-.76	.71	1.0	-2.76	1.24
Group 1	.23	.69	1.0	-1.70	2.17
Group 2 vs.					
Group 1	.99	.60	.96	-.68	2.67

* $p < 0.05$

Question 3: *What is the relationship between participants' income levels and their environmental KAB scores?*

One-way between groups analysis was conducted to explore the impact of income on knowledge, attitudes, and behavior scores. Participants were divided into six groups according to their income levels (Group 1: \$15,000 or less; Group 2: Greater than \$15,000 to \$30,000; Group 3: Greater than \$30,000 to \$50,000; Group 4: Greater than \$50,000 to \$75,000; Group 5: Greater than \$75,000 to \$100,000; Group 6: Over \$100,000). There was a statistically significant difference at the $p < .05$ level between these groups for only the knowledge and behavior scores (See Table 12). Due to attitudes' variable not meeting $p < .05$ significance level criteria, a post hoc analysis for comparing this variable and the KAB scores, was not conducted.

Table 12

Summary of Income Levels and KAB's Analysis of Variance (ANOVA) Results

Variable	Sum of Squares	df	Mean Square	F	p
Knowledge					
Between Groups	553.85	5	110.77	18.46	.00*
Within Groups	5,323.64	887	6.00		
Total	5877.49	892			
Attitudes					
Between Groups	25.72	5	5.14	.616	.69
Within Groups	7,342.95	879	8.35		
Total	7,368.67	884			
Behaviors					
Between Groups	957.20	5	191.44	4.74	.00**
Within Groups	36,135.79	894	40.42		
Total	37,093.00	899			

** $p < 0.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental knowledge and income, Group 1's (\$15,000 or less) mean score ($M=4.03$, $SD=2.22$) was significantly different (lower) from each of the other five groups (see Table 13). Group 2's (Greater than \$15,000 to \$30,000) mean score ($M=5.51$, $SD=2.38$) was significantly different from each of the other groups except Group 3 (Greater than \$30,000 to \$50,000). Group 2 and Group 3's ($M=5.92$, $SD=2.46$) mean scores did not differ significantly from each other. Group 3's mean was significantly different from Group 1 and Group 6. Group 4 (Greater than \$50,000 to \$75,000) and Group 5's (than \$75,000 to \$100,000) mean scores were each significantly different (higher) than Group 1 and Group 2. Group 6's (Over \$100,000) and Group 5's mean scores were significantly different (higher) from Group 1, Group 2 and Group 3's mean scores. Group 4 ($M=6.56$, $SD=2.53$), Group 5 ($M=6.67$, $SD=2.41$) and Group 6's ($M=7.06$, $SD=2.50$) mean environmental knowledge scores however did not differ significantly from each other.

Table 13

Bonferroni Comparison for Income Levels and Environmental Knowledge

Variable	Mean Knowledge Score Difference	Std. Error	<i>p</i>	95% CI	
				Lower Bound	Upper Bound
Group 6 vs.					
Group 5	.40	.29	1.0	-.45	1.24
Group 4	.50	.26	.75	-.25	1.25
Group 3	1.15*	.26	.00	.39	1.91
Group 2	1.55*	.28	.00	.73	2.37
Group 1	3.03*	.36	.00	1.96	4.10
Group 5 vs.					
Group 4	.10	.28	1.0	-.71	.92
Group 3	.75	.28	.11	-.07	1.58
Group 2	1.16*	.30	.00	.27	2.04
Group 1	2.64*	.38	.00	1.52	3.75
Group 4 vs.					
Group 3	.65	.25	.13	-.08	1.37
Group 2	1.05*	.27	.00	.26	1.84
Group 1	2.53*	.36	.00	1.49	3.58
Group 3 vs.					
Group 2	.40	.27	1.0	-.40	1.20
Group 1	1.88*	.36	.00	.83	2.94
Group 2 vs.					
Group 1	1.48*	.37	.00	.38	2.58

**p* < 0.05

There was not a statistically significant difference at the $p < .05$ level between the income level groups and attitude scores. The mean scores and standard deviations for environmental attitudes and income groups are provided below (Table 14).

Table 14

Environmental Attitude means and standard deviations for income levels

Variable	Environmental Attitudes
\$15,000 or less	$M=14.49, SD=3.13$
Greater than \$15,000 to \$30,000	$M=14.70, SD=2.93$
Greater than \$30,000 to \$50,000	$M=14.49, SD=2.98$
Greater than \$50,000 to \$75,000	$M=14.67, SD=2.71$
than \$75,000 to \$100,000	$M=14.96, SD=2.69$
Over \$100,000	$M=14.44, SD=3.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and income, only Group 6's mean ($M=37.87, SD=6.42$) was significantly different (higher) from the Group 1 ($M=34.61, SD=7.65$), Group 2 ($M=34.94, SD=6.69$), and Group 3 ($M=35.55, SD=6.63$) behavior score means (see Table 15). Group 4 ($M=36.44, SD=5.60$), Group 5 ($M=35.76, SD=5.89$) and Group 6's s mean environmental behavior scores did not differ significantly from each other.

Table 15

Bonferroni Comparison for Income Levels and Environmental Behavior

Variable	Mean Behavior Score Difference	Std. Error	<i>p</i>	95% CI	
				Lower Bound	Upper Bound
Group 6 vs.					
Group 5	2.12	.75	.07	-.07	4.31
Group 4	1.44	.66	.44	-.51	3.38
Group 3	2.33*	.67	.00	.36	4.29
Group 2	2.94*	.73	.00	.81	5.07
Group 1	3.26*	.94	.01	.48	6.04
Group 5 vs.					
Group 4	.10	.28	1.0	-.71	.92
Group 3	.75	.28	.11	-.07	1.58
Group 2	1.16*	.30	.00	.27	2.04
Group 1	2.64*	.38	.00	1.52	3.75
Group 4 vs.					
Group 3	.65	.25	.13	-.08	1.37
Group 2	1.05*	.27	.00	.26	1.84
Group 1	2.53*	.36	.00	1.49	3.58
Group 3 vs.					
Group 2	.40	.27	1.0	-.40	1.20
Group 1	1.88*	.36	.00	.83	2.94
Group 2 vs.					
Group 1	1.48*	.37	.00	.38	2.58

**p* < 0.05

Independent samples t-tests were used to compare mean scores for females and males for the following question:

Question 4: *What is the relationship between gender and environmental KAB scores?*

The dependent variables knowledge, attitudes, and behaviors were looked at separately (see Table 16). There was a significant effect for gender and environmental knowledge scores $t(991) = 10.92, p = .00$, with males receiving higher environmental knowledge scores than females. The magnitude of the differences in the means was moderate (eta squared = .107) since almost 11% of the variance in environmental knowledge is explained by gender. There was a significant difference in attitude scores for males and females, $t(981) = -3.25, p = .00$. Females had slightly higher mean environmental attitude scores than males. The magnitude of the differences in the means was very small (eta squared = .010). There was also a significant effect for gender and environmental behavior scores $t(998) = -2.72, p = .01$, with females having higher environmental behavior scores than males. The magnitude of the differences in these means was very small also (eta squared = .007).

Table 16

KAB means and standard deviations for females and males

Variable	Females	Males
Knowledge	$M=5.46, SD=2.31$	$M=7.16, SD=2.58$
Attitudes	$M=14.80, SD=2.81$	$M=14.20, SD=2.98$
Behaviors	$M=36.57, SD=6.42$	$M=35.45, SD=6.42$

Multiple regression was conducted for the final two research questions to consider if any statistically significant correlations existed between the dependent measures, a set of predictor variables, and non-formal and informal environmental learning participation. Specifically, multiple regression was conducted to test whether adding informal and non-formal environmental learning participation to the other independent variables of age, education levels, gender, and income, further contributed to the predictive ability for environmental knowledge, attitudes, and behavior scores (each looked at separately).

Question 5: *How well do age, education levels, gender, income, and participants' participation in non-formal learning predict KAB scores (each looked at separately)? How much variance in the KAB scores can be explained by these independent variables?*

Knowledge scores and the predictors

A hierarchical multiple regression was conducted to assess the impacts of participation in non-formal environmental learning on environmental knowledge scores in addition to the influence of age, education, gender, income (see Table 17). Age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), education, gender, and income variables were entered at Step 1, this accounted for 21% of the variance in environmental knowledge. After entry of non-formal learning participation at Step 2, the total variance explained by the model as a whole was 25%, $F(7, 885) = 42.66, p < .0005$. In other words, participation in non-formal environmental learning can explain at least four percent of the variation of adults' environmental knowledge.

Table 17

Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Knowledge

Predictor Variables	Step 1			Step 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Intercept	4.91	.31		3.78	.34	
Individual Characteristics						
Education	.36	.06	.20**	.27	.06	.16**
Gender	-1.47	.16	-.28**	-1.39	.15	-.27**
Income	.25	.06	.15**	.21	.06	.12**
Belong to Gen Y or not	-1.11	.33	-.11**	-1.03	.32	-.10**
Belong to Gen X or not	-.68	.21	-.11**	-.66	.20	-.11**
Generation Silent or not	-.05	.19	-.01	.02	.19	.00
Environmental Learning						
Informal				.15	.02	.22**

Note. $R^2 = .21$ for Step 1; $\Delta R^2 = .25$

* $p < .05$, ** $p < 0.01$

Attitude scores and the predictors

Hierarchical multiple regression was conducted to assess the impacts of participation in non-formal environmental learning on environmental attitude scores in addition to the influences of age, education, gender, and income (see Table 18). Age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), education, gender, and income variables were entered at Step 1, this accounted for 3% of the variance in environmental attitude. After entry of non-formal learning participation at Step 2, the total variance explained by the model as a whole was 4%, $F(7, 877) = 5.41$, $p < .001$. In other words, participation in non-formal environmental learning can explain at least one percent of the variation of adults' environmental attitudes.

Table 18

Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Attitude

Predictor Variables	Step 1			Step 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Intercept	13.57	.44		12.60	.49	
Individual Characteristics						
Education	.24	.09	.11**	.17	.09	.07
Gender	.47	.22	.07*	.52	.22	.08*
Income	-.03	.09	-.01	-.06	.08	-.03
Belong to Gen Y or not	-1.37	.47	-.10**	-1.31	.46	-.10**
Belong to Gen X or not	-.54	.29	-.07	-.52	.29	-.07
Generation Silent or not	-.14	.27	-.02	-.08	.27	-.11
Environmental Learning						
Non-formal				.13	.03	.15**

Note. $R^2 = .03$ for Step 1; $\Delta R^2 = .04$ for Step 2

* $p < .05$, ** $p < 0.01$

Behavior scores and the predictors

Hierarchical multiple regression was conducted to assess the impacts of participation in non-formal environmental learning on environmental behavior scores in addition to age, education, gender, and income (see Table 19). Age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), education, gender, and income variables were entered at Step 1, this accounted for 8% of the variance in environmental behaviors. After entry of non-formal learning participation at Step 2, the total variance explained by the model as a whole was 17%, $F(7, 892) = 26.33, p < .0005$. In other words, participation in non-formal environmental learning can explain at least nine percent of the variation of adult's environmental behaviors.

Table 19

Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Behavior

Predictor Variables	Step 1			Step 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Intercept	33.16	.84		29.14	.90	
Individual Characteristics						
Education	.58	.16	.13**	.27	.16	.06
Gender	1.50	.42	.12**	1.81	.40	.14**
Income	.31	.16	.07	.16	.15	.04
Belong to Gen Y or not	-3.66	.88	-.14**	-3.40	.84	-.13**
Belong to Gen X or not	-2.22	.55	-.14**	-2.13	.52	-.14**
Generation Silent or not	-2.27	.51	-.16**	-2.04	.49	-.14**
Environmental Learning						
Non-formal				.53	.06	.31**

Note. $R^2 = .08$ for Step 1; $\Delta R^2 = .17$

* $p < .05$, ** $p < 0.01$

Question 6: *How well do age, education levels, gender, income, and participants' participation in informal learning predict KAB scores (each looked at separately)? How much variance in the KAB scores can be explained by these independent variables?*

Knowledge scores and the predictors

A hierarchical multiple regression was conducted to assess the impacts of participation in informal environmental learning on environmental knowledge scores in addition to the influence of age, education, gender, income (see Table 20). Age, education, gender, and income variables were entered at Step 1, this accounted for 21% of the variance in environmental knowledge. After entry of informal learning participation at Step 2, the total variance explained by the model as a whole was 25%, $F(7, 885) = 42.83, p < .0005$. In other words, participation in informal environmental learning can explain at least four percent of the variation of adults' environmental knowledge.

Table 20

Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Knowledge

Predictor Variables	Step 1			Step 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Intercept	4.91	.31		2.70	.43	
Individual Characteristics						
Education	.36	.06	.20**	.33	.06	.19**
Gender	-1.47	.16	-.28**	-1.44	.15	-.28**
Income	.25	.06	.15**	.24	.06	.14**
Belong to Gen Y or not	-1.11	.33	-.11**	-.99	.32	-.10**
Belong to Gen X or not	-.68	.21	-.11**	-.67	.20	-.11**
Generation Silent or not	-.05	.19	-.01	.13	.19	.02
Environmental Learning						
Informal				.12	.02	.22**

Note. $R^2 = .21$ for Step 1; $\Delta R^2 = .25$

* $p < .05$, ** $p < 0.01$

Attitude scores and the predictors

A hierarchical multiple regression was conducted to assess the impacts of participation in informal environmental learning on environmental attitude scores in addition to the influence of age, education, gender, income (see Table 21). Age, education, gender, and income variables were entered at Step 1, this accounted for 3% of the variance in environmental attitude. After entry of informal learning participation at Step 2, the total variance explained by the model as a whole was 6%, $F(7, 877) = 7.34$, $p < .001$. In other words, participation in informal environmental learning can explain at least three percent of the variation of adults' environmental attitudes.

Table 21

Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Attitude

Predictor Variables	Step 1			Step 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Intercept	13.57	.44		10.91	.61	
Individual Characteristics						
Education	.24	.09	.11**	.21	.08	.09*
Gender	.47	.22	.07*	.49	.22	.08*
Income	-.03	.09	-.01	-.05	.08	-.02
Belong to Gen Y or not	-1.37	.47	-.10**	-1.24	.46	-.09*
Belong to Gen X or not	-.54	.29	-.07	-.53	.28	-.07
Generation Silent or not	-.14	.27	-.02	-.08	.27	.11
Environmental Learning						
Informal				.14	.02	.20**

Note. $R^2 = .03$ for Step 1; $\Delta R^2 = .04$ for Step 2

* $p < .05$, ** $p < 0.01$

Behavior scores and the predictors

A hierarchical multiple regression was conducted to assess the impacts of participation in informal environmental learning on environmental behavior scores in addition to the influence of age, education, gender, income (see Table 22). Age, education, gender, and income variables were entered at Step 1, this accounted for 8% of the variance in environmental behavior. After entry of informal learning participation at Step 2, the total variance explained by the model as a whole was 21%, $F(7, 892) = 34.27$, $p < .0005$. In other words, participation in informal environmental learning can explain at least thirteen percent of the variation of adults' environmental behaviors.

Table 22

Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Behavior

Predictor Variables	Step 1			Step 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Intercept	33.16	.84		23.76	1.09	
Individual Characteristics						
Education	.58	.16	.13**	.48	.15	.11**
Gender	1.50	.42	.12**	1.64	.39	.13**
Income	.31	.16	.07	.24	.15	.06
Belong to Gen Y or not	-3.66	.88	-.14**	-3.19	.82	-.12**
Belong to Gen X or not	-2.22	.55	-.14**	-2.17	.51	-.14**
Generation Silent or not	-2.27	.51	-.16**	-1.50	.48	-.11**
Environmental Learning						
Non-formal				.49	.04	.37**

Note. $R^2 = .08$ for Step 1; $\Delta R^2 = .17$

* $p < .05$, ** $p < 0.01$

Summary

This chapter reports the ANOVA, t-tests and multiple regression results for this study. It was found that there is a significant effect of age, education, income and gender groups, informal and non-formal learning on the adults' environmental knowledge, attitude and behavior. For gender and environmental knowledge, attitudes, and behaviors, Multiple regression results from this chapter indicated that both non-formal and informal learning participation, when added to age, education, income and gender, added to each of the environmental knowledge, attitude, and behavior models significantly. These results will be discussed further in chapter 5.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study was conducted to examine the impact of non-formal and informal learning on Minnesota adults' environmental knowledge, attitudes, and behaviors. A secondary data analysis was conducted to examine these factors from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008). Specifically, this study was designed to explore what factors might positively and negatively influence adult environmental knowledge, attitudes, and pro-environmental behaviors as indicated by Minnesota adult environmental knowledge, attitude and behavior scores. MarketLine Research used random digit dialing and computer aided telephone interviewing to complete one thousand surveys for the report card. Chapter four's results will be summarized, discussed and presented in this chapter in order of the questions, and then in relation to the literature. Conclusions and recommendations will also be given.

Summary of Findings

Research Question 1

What is the relationship between an individual's generation (age range) and their KAB scores?

There was a statistically significant difference at the $p < .05$ level between the age groups for only the knowledge and behavior scores. For environmental knowledge and age, post-hoc comparisons indicated that only the youngest age group, Generation Y's, mean environmental knowledge score was significantly different (lower) from each of the

other three generations' mean environmental knowledge scores. Out of 13 factual environmental knowledge questions, this age group could correctly answer an average of five of the questions. This was at least one point below the other three age groups.

For environmental behavior and ages, only the Baby Boomer's mean was significantly different (higher) than the other age groups. Baby Boomers scored on average about two points higher than the other age groups.

Returning to Dunlap and Van Liere's (1980) application of Mannheim's theory (1952) regarding significant events and possible generational impacts, it could be assumed that people who were teenagers and older during significant environmental events could have formed, "an ecology-minded generation whose commitment to environmental reform should not disappear as they move into adulthood" (Dunlap & Van Liere, 1980, p. 183). Many Baby Boomers were at least teenagers or older during many significant environmental events in the United States (Rachel Carson's book; Cuyahoga River catching on fire; Love Canal, Three Mile Island, and Chernobyl). This could account for part of the reason Baby Boomers had the highest environmental knowledge, attitude, and behavior mean scores. These findings do raise a question regarding why the youngest adult generation scored lowest on the factual environmental knowledge questions when environmental education has been available, and used, in primary and secondary education for the past thirty years? It could be argued that Mannheim's theory applies to Generation Y as well since environmental disasters that were well covered in the media and caused concerns for the older generations, such as Chernobyl, and the

Exxon Valdez oil spill, occurred when the eldest of this cohort were only seven and ten years old respectively.

Research Question 2

What is the relationship between an individual's level of education and their KAB scores?

There was a statistically significant difference at the $p < .05$ level between the education levels for environmental knowledge, attitude and behavior scores. For knowledge and education levels, as education level increased, participants' environmental knowledge scores increased slightly as well. Four-year college graduates, and participants who indicated they had graduate degrees, had significantly higher mean environmental knowledge scores than the other three education groups. These two education groups correctly answered an average of seven of the thirteen knowledge questions.

With regard to environmental knowledge, research indicates that higher levels of education achieved offer an advantage in respondent environmental knowledge scores (Kaplowitz & Levine, 2005; NEETF, 2001a; Nerbonne & Schreiber, 2005; SKEKAB, 2004); White, 2006). The results reported here support these findings. For environmental attitudes and education levels, only Group 5's (graduate degree) mean attitude scores were significantly different (higher) than both Group 3 (two-year degree) and Group 1 (high school grad, GED or less). With the highest possible score of eighteen for the environmental attitudes scale, participants with a graduate degree had a mean environmental attitude score of about fifteen. This was a slight environmental attitude

increase for group five with their averaging one point higher than groups one and three. Ewert and Baker (2001) comment that “much of the research indicates that there is a significant relationship between level of education and expressed environmental attitudes and concern” (p. 689). Findings here with regard to reported formal education attained and environmental attitudes indicate that there is a positive significant relationship between level of education and environmental attitudes. Finally, for education levels and environmental behaviors, participants with at least a four-year college degree (education groups four and five) had mean behavior scores that were significantly different from Group 1 (high school grad, GED or less). Group 1’s environmental behaviors scores averaged almost two points less than college graduates, and almost three points less than participants with a graduate degree. These findings align with the weak positive relationship between level of education and environmental behaviors found in Hines, Hungerford and Tomera (1987) meta-analysis on responsible environmental behavior research.

Research Question 3

What is the relationship between adults’ income levels and their KAB scores?

There was a statistically significant difference at the $p < .05$ level between the income groups for only the environmental knowledge and behavior scores.

There was a positive relationship between income levels and environmental knowledge scores. To summarize the positive relationship between the six income groups and environmental knowledge scores, participants who reported a total household income of \$15,000 or less (Group 1), correctly answered an average of four of the environmental

knowledge questions which was lower than all other income groups. This can be compared to participants who reported a total household income of \$100,000 or more (Group 6), who correctly answered an average of seven out of the thirteen environmental knowledge questions, which was higher than all other income groups.

This study aligns with the positive relationship between income levels and environmental knowledge indicated in related studies (Pennsylvania Center for Environmental Education, 2001).

For income groups and environmental behaviors, only Group 6's average mean environmental behavior score was significantly different (higher) from Groups 1, 2 and 3. Participants who reported a total household income of \$100,000 or more then reported slightly higher environmental behaviors (average environmental behavior scores were 2 to 3 points higher) than Groups 1, 2 and 3. These findings support the weak positive relationship between pro-environmental behavior and income indicated in Mancl, Carr and Marrone's (2003) and Hines, Hungerford and Tomera's (1987) studies.

Research Question 4

What is the relationship between gender and KAB scores?

There was a significant effect for gender and environmental knowledge, attitude and behavior scores. For the factual environmental knowledge questions, males correctly answered an average of seven of the thirteen questions. Females correctly answered an average of five of the thirteen environmental knowledge questions. For both attitudes to environmental laws, and participating in environmentally friendly behaviors, females had slightly higher average scores than males.

These results align with Kilbert (2000), Murphy (2002, 2004), White (2006), Coyle (2005), Bord and O'Connor (1997), Hines (1987), and SKEKAB (2004) research findings that indicated that: males have higher environmental knowledge scores than females, females have higher environmental attitudes and concern than males, and, females report more pro-environmental behaviors than males.

Research Question 5

How well do age, education levels, gender, income, and adults' participation in non-formal learning predict KAB scores (each looked at separately)? How much variance in the KAB scores can be explained by these independent variables?

Since the research in chapter two indicated that age, education, income and gender are significant predictors of environmental knowledge, attitude, and behavior scores (each looked at separately here), these were entered into the model first. The exploratory variable, non-formal environmental learning was then entered into the model. The predictor variables age, education, income and gender accounted for approximately 21%, 3% and 8% respectively of environmental knowledge, attitudes, and behaviors. When non-formal environmental learning was added to these models it contributed significantly to predicting environmental knowledge, attitude, and behavior scores. These prediction models increased to 25% for environmental knowledge, 4% for environmental attitudes and 17% for environmental behaviors after non-formal environmental learning participation was added.

Results from the hierarchical regression analysis align with the findings from the correlation analysis but other noteworthy results are also revealed. After controlling for

the effects of demographic variables on environmental knowledge, attitudes, and behaviors, non-formal learning participation appears to be a moderate contributor to both environmental knowledge and environmental behaviors. Non-formal learning participation was not a major contributor to environmental attitude.

These findings are consistent with a meta-analysis on environmental literacy in the United States (Volk & McBeth, 1996, 1998). The Volk and McBeth (1996, 1998) white paper included studies examining the effectiveness of environmental formal, non-formal, and informal instruction, and literacy components such as environmental knowledge, attitudes, and behaviors. For environmental knowledge they found that for the six studies that measured aspects of socio-political knowledge, all reported positive changes in knowledge as a result of instruction. Eight other studies which looked at changes in ecological knowledge as a result of instruction indicated positive knowledge changes as well. These findings indicating environmental knowledge improvement with various types of instruction (formal, non-formal and informal) align with the findings here. For environmental instruction and responsible environmental behavior, of the seven studies examined five studies reported positive changes (Volk & McBeth, 1996, 1998). While this does not fully account for the positive contribution of non-formal environmental learning on environmental behaviors that were indicated here, these studies do show a positive trend for environmental behavior change across various environmental instruction venues.

Research Question 6

How well do age, education levels, gender, income, and adults' participation in informal learning predict KAB scores (each looked at separately)? How much variance in the KAB scores can be explained by these independent variables?

Since the research in chapter two indicated that age, education, income and gender are significant predictors of environmental knowledge, attitude and behavior scores (each looked at separately here), these were entered into the model first. The exploratory variable, informal environmental learning was then entered into the model. The predictor variables age, education, income and gender accounted for approximately 21%, 3% and 8% respectively of environmental knowledge, attitudes, and behaviors. When informal environmental learning was added to these models it contributed significantly to predicting environmental knowledge, attitude, and behavior scores. These prediction models increased to 25% for environmental knowledge, 6% for environmental attitudes and 21% for environmental behaviors after informal environmental learning participation was added.

After controlling for the effects of demographic variables on environmental knowledge, attitudes, and behaviors, informal learning participation appears to be a slight contributor to environmental attitudes and a moderate contributor to environmental knowledge and behaviors. While several studies include information regarding where people get their environmental information (Coyle, 2005; Murphy, 2002; Murphy & Olson, 2008; NEETF, 1997; NEETF, 1998; Rickinson, 2001; White, 2006), studies combining these environmental learning participation items (internet, newspapers,

magazines, television, radio, conversations with friends, neighbors and children) into an informal learning participation variable to consider possible contributions to environmental knowledge, attitude, and behavior scores, could not be found.

While the potential for using non-formal and informal education venues to improve and support environmental KABs has been recognized, researchers and practitioners have raised concerns regarding possible quality and effectiveness of these venues (Clover, 2002b; Coyle, 2005; Filho & Bandeira, 1995; Nyirenda, 1995).

Conclusions based on these findings will be discussed next.

Conclusions

Using ongoing studies like this as an assessment and baseline to better understand the environmental KABs of Minnesota adults can help educators better target their education efforts toward improving environmental literacy. Based on the findings, conclusions on environmental literacy in Minnesota are:

1. Basic environmental knowledge remains questionable among adults in Minnesota with respondents correctly answering, on average, six out of the thirteen environmental knowledge questions. These questions, are meant to gauge adult's knowledge of popular environmental topics such as the major contributors to air pollution, water pollution, and home energy usage, as well as why species become extinct, benefits of wetlands, and how most of the electricity used in Minnesota is generated. These questions are not intended to be difficult. Yet, many incorrectly answer these, and as concerning, at least 10

percent to as high as 42 percent responded with “do not know” when asked the environmental knowledge questions. It can easily be argued that it is imperative for adults to know major contributors to air and water pollution in order to recognize that individual transportation decisions, and even washing cars in driveways or adding fertilizers, pesticides or herbicides to our lawns do have an impact on local air and water quality. Similarly, when less than half of those questioned correctly responded that heating rooms uses most of the energy in people’s homes, then this means that there are many Minnesota residents who may not be able to thoughtfully decide how to address this in order to find options for keeping warmer and lowering their fall, winter, and spring energy costs in our cold climate. These knowledge scores may indicate that many Minnesota adults are nominally environmentally literate, as Roth, (1991) suggests, “although aware of the terms or vocabulary, has little or no depth of understanding of them, has only rudimentary process skills.”

Therefore, better targeted education efforts for these areas across the many education options is important if we are to support these types of pragmatic environmental knowledge.

2. Many Minnesota adults do report positive pro-environmental attitudes. For instance, 60% or more answered that laws and regulations have not gone far enough with regard to air pollution, water pollution, chemical in food, energy conservation and global warming. Only land development was questionable with 46% reporting laws and regulations are about just right for these, and

only 28% reporting the laws and regulations have not gone far enough. When combining all of these questions however, the average environmental attitude score was 14.5 out of 18 indicating pro-environmental attitude leanings.

3. Pro-environmental behaviors were mixed with some reporting they engage in participating in some pro-environmental behaviors and not in others. For example, at least 85% report they recycle and turn off lights or appliances when leaving a room most or almost all of the time. However, when asked about whether they bike or walk to work, use the bus, or carpool with others, at least 70% reported that they rarely or never do these. For the other six questions on purchasing items that are energy efficient, limiting air conditioner use in summer, lowering the thermostat in winter, accelerating slowly, donating to environmental groups and buying organic foods, behaviors were mixed. It is commonly recognized that some of these behaviors are due to economic restraints and convenience factors.
4. Reported adult environmental education participation in both non-formal and informal venues did improve environmental KAB models. Since the environmental behavior prediction was most improved by adding non-formal and informal learning participation, these learning options should be looked at more carefully for predictive possibilities. However, since at least 75% of the environmental KAB models remain unaccounted for, more work needs to be done to attain a clearer representation of Minnesota adults and their overall environmental literacy.

Implications for Adult Education Practice and Recommendations

Environmental knowledge, environmental attitudes, and environmental behaviors, did not show up when searching adult education journals. Hill (2002) mentions however that adult education has only “recently begun to map the terrain” (p. 183) of the environmental movement, though there were attempts more than thirty years ago. Adult education researchers and practitioners have been researching and publishing about adults and environmental learning intermittently however. As part of their environmental adult education text, Clover, Follen and Hall (2000) highlight the importance of finding out more about learners prior to teaching. They posit, “this information is important when planning your activities to not only match goals but also the identities of the participants” (Clover, Follen & Hall, 2000, p. 27). This research study which offers information about Minnesota adults and their environmental knowledge, attitudes, and behaviors, as well as their participation in non-formal and informal learning options, complements this aspect of pre-planning.

With regard to environmental knowledge, research and reports that consider environmental knowledge often consider how demographics (age, education, income and gender for example) correlate with environmental knowledge. Relationships vary with regard to environmental knowledge and demographic variables. Some literature indicates that research that tests factual environmental knowledge scores from a survey and correlates this with demographic variables are failing to recognize that there are various types of environmental knowledge, and that interactions can vary specifically based on the type of knowledge being studied (Courtenay-Hall & Rogers, 2002). An example of a

possible disconnect could be suggestions of other ways of knowing (Clover, 2002), which is studied in environmental adult education research. Research here seeks to identify people's local ecological knowledge to try and allow them to self-define local environmental issues and problem solve as a community (Clover, 2002b, Kapoor, 2000; Oliver, 2000; Tabiedi, 2004; Strathy & Tabunakawai, 2004). Suggested here is that individuals may know more about local environmental topics and issues. This should not be assumed to suggest that adult education is not interested in general KABs as much as the environmental education field however. Future research could be carried out to see how these various ways of studying adults and KABs can better inform both fields. This would allow opportunity to combine research review efforts to determine gaps, best practices in environmental education targeting, and-or a more holistic learning theory approach (Yang, 2003), for understanding and improving environmental KABs.

Being able to take a look at several instruments for assessing and evaluating environmental knowledge, attitudes, and behaviors, such as the ones for this study, adds knowledge and options to ongoing and future environmental adult education research. A cautionary note should be mentioned with regard to the instruments from this study since the Cronbach alpha reliability analysis were .73 for knowledge, .79 for attitudes, and .62 for behaviors. A limitation of this secondary data analysis was being limited to another researcher's existing data set. Attempts could be made to improve these in future studies or to use other knowledge, attitude or behavior instruments. In addition to this, pulling the adult environmental literacy state and national reports into the adult education realm is useful to identify other adult literacy literature for considering connections.

Finally, bringing this study back to the introduction, part of my original interests in doctoral work in adult education stemmed from questions regarding adults and learning from my Public Administration Master's professional report on the high level nuclear repository potential at Yucca Mountain in Nevada. It was hoped that this study would be able to offer some insight into local environmental knowledge and nuclear power plant waste in Minnesota. Unfortunately, there were not enough people in this study's sample from the counties where nuclear power plants are located to be able to test whether their knowledge of nuclear waste disposal is possibly higher than that of other Minnesota citizens who do not live near the nuclear power plants. Future research could look into local environmental knowledge regarding specific areas such as nuclear and wind energy to see if environmental knowledge on specific topics is localized or if popular environmental topics and issues are unknown across the population. This information could support future research and education efforts.

Finally, while this study was not able to answer who is responsible for adult environmental education, as mentioned in the introduction, this study does provide some meaningful information on where adults report they gain their environmental learning. More importantly, participation in non-formal and informal education venues improved environmental knowledge, attitude, and behavior models, providing evidence for the value and need for non-formal and informal environmental adult education venues. While causality cannot be proven here, this too is a worthwhile direction for future research.

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APPENDICES

Appendix A

Minnesota Environmental Education Statutes 2007

115A.073 Environmental education goals and plan

The environmental education program described in this section and section 115A.074 has these goals for the pupils and other citizens of this state:

(a) Pupils and citizens should be able to apply informed decision-making processes to maintain a sustainable lifestyle. In order to do so, citizens should:

(1) understand ecological systems;

(2) understand the cause and effect relationship between human attitudes and behavior and the environment;

(3) be able to evaluate alternative responses to environmental issues before deciding on alternative courses of action; and

(4) understand the effects of multiple uses of the environment.

(b) Pupils and citizens shall have access to information and experiences needed to make informed decisions about actions to take on environmental issues.

(c) For the purposes of this section and section 115A.074, "state plan" means "Greenprint for Minnesota: A State Plan for Environmental Education."

History: 1990 c 595 s 1; 1993 c 224 art 12 s 32; 1993 c 374 s 22; 1Sp1995 c 3 art 11 s 3,20; 1998 c 397 art 3 s 98,103; art 11 s 3

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Appendix B

The Third Minnesota Report Card on Environmental Literacy

Survey: Final Version

Quota: 1,000 respondents statewide

- Q1. To begin I am going to read you a list of different environmental topics and ask how much do you feel you know about each. Please use a 5-point scale where 1 means A lot and 5 means Nothing at all. You may use any number from 1 to 5. How much would you say you know about [Insert first item]? 11. Refused, 12. Don't know
- a. Environmental problems
 - b. Air pollution
 - c. Energy issues
 - d. Water quality
 - e. Global warming
- Q2. Next I am going to ask you some questions about environmental laws and regulations. For each of the following please tell me how familiar you are with the laws and regulations concerning the topic. Use a 5-point scale where 1 means Very familiar and 5 means Not at all familiar. How familiar are you with the laws and regulations concerning [INSERT FIRST ITEM]. 11. Refused, 12. Don't know
- a. Air Pollution
 - b. Water pollution
 - c. Chemicals in your food
 - d. Land development
 - e. Energy conservation and energy efficiency
 - f. Global warming
- Q3. At the present time, do you think existing laws and regulations preventing air pollution have gone too far, not far enough, or have struck about the right balance?
1. Gone too far
 2. Not far enough
 3. Struck about the right balance
 11. Refused
 12. Don't know

- Q4. At the present time do you think laws and regulations preventing water pollution have gone too far, not far enough, or have struck about the right balance?
1. Gone too far
 2. Not far enough
 3. Struck about the right balance
 11. Refused
 12. Don't know
- Q5. At the present time do you think laws and regulations regulating chemicals in your food have gone too far, not far enough, or have struck about the right balance?
1. Gone too far
 2. Not far enough
 3. Struck about the right balance
 11. Refused
 12. Don't know
- Q6. At the present time do you think laws and regulations controlling land development in your local area have gone too far, not far enough, or have struck about the right balance?
1. Gone too far
 2. Not far enough
 3. Struck about the right balance
 11. Refused
 12. Don't know
- Q7. At the present time do you think laws and regulations on energy conservation and energy efficiency have gone too far, not far enough, or have struck about the right balance?
1. Gone too far
 2. Not far enough
 3. Struck about the right balance
 11. Refused
 12. Don't know
- Q8. At the present time do you think laws and regulations on global warming have gone too far, not far enough, or have struck about the right balance?
1. Gone too far
 2. Not far enough
 3. Struck about the right balance
 11. Refused
 12. Don't know

Q9 through Q16

Q. The next group of questions is about issues that have been covered in the media in the past couple of years. Media includes television, newspapers, magazines, internet and other sources. Each question has four or five possible answers. If you don't know the answer, you can just state that you don't know. First:

Q9. What is the most common cause of pollution of streams, rivers and oceans? Is it...

[READ LIST]

1. Sewage from treatment plants,
2. Surface water running off yards, city streets, paved lots, and farm fields,
3. Oil from boats, or
4. Waste from factories
10. Other
11. Refused
12. Don't know

Q10. The Twin Cities area has had a number of air pollution alerts in the past few years, partially due to smog. What is the primary source of this smog? Is it...

[READ LIST]

1. Power plants,
2. The exhaust of motor vehicles,
3. Waste incinerators, or
4. Smoke from fireplaces
10. Other
11. Refused
12. Don't know

Q11. Mercury from air pollution is a health concern in lakes because it settles out of the air into water. What is the largest source of mercury in Minnesota's air? [READ LIST]

1. Coal-burning power plants,
2. Exhaust from motor vehicles,
3. Burning of batteries in incinerators, or
4. Smoke from fireplaces
10. Other
11. Refused
12. Don't know

- Q12. The Minnesota Pollution Control Agency defines global warming as “an increase in the Earth’s temperature caused by human activities....which release...greenhouse gases into the atmosphere.” Which of the following is a common greenhouse gas? [READ LIST]
1. Sulfur dioxide
 2. Carbon dioxide
 3. Nitrogen or
 4. Hydrogen
 10. Other
 11. Refused
 12. Don’t know
- Q13. All of the activities listed here are contributors of human-caused greenhouse gases in Minnesota. Which of the following is the LARGEST contributor to greenhouse gas emissions in Minnesota?
[READ LIST]
1. Agricultural operations
 2. Leakage from refrigeration systems
 3. Burning fossil fuels (COAL, OIL, GASOLINE, DIESEL AND NATURAL GAS), or
 4. Gases released from landfills
 10. Other
 11. Refused
 12. Don’t know
- Q14. What is the MOST common reason that an animal species becomes extinct? Is it because....
[READ LIST]
1. Pesticides are killing them
 2. Their habitats are being destroyed by humans
 3. There is too much hunting, or
 4. There are climate changes that affect them
 10. Other
 11. Refused
 12. Don’t know
- Q15. What is one of the MAIN benefits of wetlands? Do they... [READ LIST]
1. Help to control global climate change
 2. Help filter and store water before it enters lakes, streams, rivers or oceans
 3. Prevent the spread of undesirable plants and animals, or
 4. Provide good sites for landfills
 10. Other
 11. Refused
 12. Don’t know

Q16. Where does MOST of the garbage in Minnesota go? Would you say... [READ LIST]

1. Landfills
2. Waste to energy incinerators
3. Burn barrels
4. Recycling centers, or
5. Compost facilities
10. Other
11. Refused
12. Don't know

Q17. The next few questions are about energy. If you do not know the answer, you can just state that you don't know. Thinking about Minnesota, which of the following uses the most energy in people's homes? Is it... [READ LIST]

1. Lighting rooms
2. Heating rooms
3. Cooling rooms,
4. Heating water, or
5. Refrigerating food
10. Other
11. Refused
12. Don't know

Q18. In the past ten years, has the fuel efficiency of vehicles in the U.S... [READ LIST]

1. Increased
2. Remained the same
3. Decreased
4. Not been tracked
10. Other
11. Refused
12. Don't know

Q19. Which of the following do you think energy experts say is the fastest and most cost-effective way to address our overall energy needs? Would you say... [READ LIST]

1. Develop all possible domestic sources of oil and gas
2. Build more nuclear power plants
3. Build more hydroelectric power plants, or
4. Become more energy efficient?
10. Other
11. Refused
12. Don't know

Q20. Thinking about Minnesota, how is MOST of the electricity used in Minnesota generated? Is it...

[READ LIST]

1. With fossil fuels (such as coal)
2. With nuclear power
3. With wind energy, or
4. With hydro power
10. Other
11. Refused
12. Don't know

Q21. In Minnesota, what do we do with nuclear waste now? Do we..... [READ LIST]

1. Reuse it as nuclear fuel
2. Send it to another state for storage
3. Dump it in landfills, or
4. Monitor it at the nuclear power plant
10. Other
11. Refused
12. Don't know

Q22. Which of the following do you think is the BEST way to address America's energy needs?

[READ LIST]

1. Drilling for more oil and gas in the US.
2. Developing renewable forms of energy (If necessary: SUCH AS WIND AND SOLAR)
3. Expanding nuclear power capabilities
4. Using coal more effectively
11. Refused
12. Don't know

ASK IF 'YES' TO Q22a

Q22b. Does this include drilling on public lands such as national forests, wildlife refuges, national grasslands, etc.?

1. Yes
2. No
11. Refused
12. Don't know

Q23. Do you think environmental education should be provided in our schools?

1. Yes
2. No
11. Refused
12. Don't know

ASK IF 'YES' TO Q23

Q23b. Do you feel MOST of the funds should come from... [READ LIST]

1. Parents
2. Businesses
3. Schools
4. A state fund
11. Refused
12. Don't know

Q24. People get information about the environment in a variety of ways. Please tell me how much you use each of the following ways to get environmental information. Use a 5-point scale where 1 means Use a lot and 5 means Do not use at all. You may use any number from 1 to 5. 11. Refused, 12. Don't know. How much do you use...

- a. Internet
- b. Newspapers – hardcopy or online
- c. Magazines – hardcopy or online
- d. Television
- e. Radio
- f. Conversations with friends or neighbors
- g. Conversations with children about their environmental learning experiences

Q25. Now, different sources may provide varying amounts of environmental information. From each of the following sources please tell me how much environmental information you get. Use a 5-point scale where 1 means Get a lot and 5 means Get none at all. You may use any number from 1 to 5. 11. Refused, 12. Don't know

- a. Government agencies (STATE OR FEDERAL)
- b. Conservation or Environmental Groups
- c. Environmental learning centers, including nature centers, parks, science museums, and zoos?
- d. Scientific experts

Q25e. Are there any other sources from which you get environmental information?

1. Yes
2. No

Q25ee. What are these sources?

Q26. Now, I would like to ask you about some of the things you may or may not do in your day-to-day life. Would you please tell me how often you do each of the following. Use a 5-point scale where 1 means Almost always do it and 5 means

Never do it. You may use any number from 1 to 5. If it does not apply to you, please tell me. 11. Refused 13. Not applicable

First, how often do you...

- a. Recycle things such as newspapers, cans, and glass
- b. Turn off lights and electrical appliances when not in use or when you leave the room
- c. Bike or walk to work
- d. Use the bus
- e. Carpool with others
- f. Purchase lamps, light-bulbs and appliances that are energy efficient
- g. Run air conditioner less often in the summer
- h. Lower the thermostat in the winter
- i. Accelerate slowly when driving
- j. Donate money annually to an environmental group or organization
- k. Buy organic foods on a regular basis
- l. Buy locally-grown foods on a regular basis

[ASK IF 'SOMETIMES DO IT' OR 'FREQUENTLY DO IT' IN Q27

Q26b. You mentioned that you donate money annually to an environmental group or organization. Can you estimate how much you annually donate to them?

11. Refused
12. Don't know

Q27. Please tell me how important each of the following is to you in deciding where you live?

Use a 5-point scale where 1 means Very Important and 5 means Not at all important. You may use any number from 1 to 5. 11. Refused, 12. Don't know

How important is |Insert|?

[READ LIST]

- a. Quality of schools.
- b. Personal safety
- c. Property taxes
- d. Distance to work
- e. Community spaces, such as parks and natural areas?
- f. Living on a larger lot

DEMOGRAPHICS

Q28. Lastly I have just a few questions to make sure we interview a representative cross-section of Minnesota residents. First, in what year were you born?

11. Refused

- Q29. What is the highest level of education that you have completed? [READ LIST]
1. Less than a high school diploma
 2. High school grad or GED
 3. 2-year degree (AA, AS, professional school if two-year degree)
 4. Some college
 5. College graduate (4 year degree, BA, BS)
 6. Graduate degree (Masters, MA, MS, MD, PhD, etc)
 11. Refused
 12. Don't know
- Q30. To make sure we have talked with a variety of people, in which Minnesota county do you currently live? [RECORD COUNTY]
- Q31. What racial or ethnic group best describes you? [DO NOT READ LIST]
1. African American
 2. American Indian
 3. Asian, Asian American, or Pacific Islander
 4. White or Caucasian
 5. Hispanic, Latino, or Spanish origin
 6. Biracial or multiracial
 7. Some other group, specify
 11. Refused
- Q31b. Other – What racial or ethnic group best describes you?
- Q32. How many hours per week do you spend outside not including time spent for your employment? [DO NOT READ LIST, SELECT RANGE]
1. None
 2. Fewer than 5 hours
 3. 5 – 10 hours
 4. 11 – 15 hours
 5. 16 – 20 hours
 6. 21 – 30 hours
 7. 31 – 40 hours
 8. More than 40 hours
 11. Refused
 12. Don't know

- Q33. For statistical purposes, it would be helpful to know the income group which comes closest to your total annual household income for 2007. This is the total household income for all members of the household, from all sources of income, **before** taxes. I am going to read some broad ranges. Please stop me when I read the correct range. [READ LIST]
1. \$15,000 or less
 2. Greater than \$15,000 to \$30,000
 3. Greater than \$30,000 to \$50,000
 4. Greater than \$50,000 to \$75,000
 5. Greater than \$75,000 to \$100,000, or
 6. Over \$100,000
 11. Refused
- Q34. Record gender.
1. Male
 2. Female

Appendix C

The Third Minnesota Report Card on Environmental Literacy

Methodology as listed in the state report (Murphy and Olson, 2008, p. 63)

Consistent with past report card surveys, the current survey used a random-digit dial sample and randomized selection within the household. Random-digit dialing ensures an equal probability of selection for all residential telephone numbers within a given locale – in this study the State of Minnesota. Randomized selection within the household further equalizes selection probabilities. Randomization was attained by selecting the adult in the household who had the most recent birthday. This respondent selection method is done at the start of the telephone interview and is based on the respondent accurately acknowledging which person in the household had a birthday last (or most recently).

Telephone numbers for the calling sample were purchased from Survey Sampling, Incorporated. Professionally trained interviewers conducted computer-assisted telephone interviews (CATI) at MarketLine Research's call center located near the University of Minnesota Minneapolis campus. Interviewing began on August 24, 2007, and continued through November 6, 2007. Interviewing was not conducted the week of Thanksgiving. Calls were made 9 a.m. to 9 p.m. Monday through Thursday, 9 a.m. to 7 p.m. Friday and noon to 5 p.m. Saturdays and Sundays. Average interview length was 16 minutes.

One thousand interviews were completed with adults throughout Minnesota. For a sample of this size, relative to the adult population of Minnesota (3,909,837 estimate by

U.S. Census Bureau, 2006), the sampling error is plus or minus 3.1 percentage points for results with a 50/50 proportional split. That is, if response to a survey question resulted in 50 percent of the sample answering “yes” and 50 percent answering “no,” it is very likely for a sampling of the entire population of Minnesota, the actual percentage of the population who give such answers would be somewhere between 46.9 and 53.1 percent. Sampling error is progressively smaller for results with uneven splits.

For the first time, the environmental literacy survey began with the use of a Tennessen warning, a commonly used disclaimer informing a potential survey respondent that participation in a study is voluntary. (*Your opinions are important to us, but participation is voluntary and all your answers will be kept confidential*).

The use of such a statement does have an impact on survey response rate – lowering cooperation as seen in increased rates of refusal to participate or increased rates of participant termination during survey administration.

The industry-standard response rate (CASRO RR3) for the study was 39 percent, with a refusal rate of 48 percent.

Reported percentages throughout the report were rounded down if less than 0.5% and rounded up if greater than 0.5%.

Appendix D

Letter of Approval from Institutional Review Board

Subject: 0808E44741 - PI Digby - IRB - Exempt Study Notification

From: irb@umn.edu

Date: Fri, 19 Sep 2008 13:13:49 -0500 (CDT)

To: digb0001@umn.edu

The IRB: Human Subjects Committee determined that the referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS.

Study Number: 0808E44741

Principal Investigator: Cynthia Digby

Title(s): The impact of learning on adult environmental knowledge, attitudes, and behaviors

This e-mail confirmation is your official University of Minnesota RSPP notification of exemption from full committee review. You will not receive a hard copy or letter. This secure electronic notification between password protected authentications has been deemed by the University of Minnesota to constitute a legal signature.

The study number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office.

If you requested a waiver of HIPAA Authorization and received this e-mail, the waiver was granted. Please note that under a waiver of the HIPAA Authorization, the HIPAA regulation [164.528] states that the subject has the right to request and receive an accounting of Disclosures of PHI made by the covered entity in the six years prior to the date on which the accounting is requested.

If you are accessing a limited Data Set and received this email, receipt of the Data Use Agreement is acknowledged.

This exemption is valid for five years from the date of this correspondence and will be filed inactive at that time. You will receive a notification prior to inactivation. If this research will extend beyond five years, you must submit a new application to the IRB before the study's expiration date.

Upon receipt of this email, you may begin your research. If you have questions, please call the IRB office at (612) 626-5654.

You may go to the View Completed section of eResearch Central at <http://eresearch.umn.edu/> to view further details on your study.

The IRB wishes you success with this research.