ENVIRONMENTAL KNOWLEDGE AND THE UNIVERSITY: A COMPARISON OF THE LEVEL OF ENVIRONMENTAL KNOWLEDGE AMONG STUDENTS AT MICHIGAN STATE UNIVERSITY

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Resource Development

2002

ABSTRACT

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This study examines environmental knowledge among Michigan State University students and the relationship between this knowledge and their college of major study. The students were found to possess higher levels of environmental knowledge than the general public. Although exceeding the national average, students' overall environmental knowledge score was not a passing grade of at least 70% correct answers.

Differences in environmental knowledge were found across colleges, that is, the academic unit housing students' major field of study. Students studying in the colleges of medicine and colleges related to natural resources and ecosystems were more knowledgeable on environmental issues and problems than students studying in the colleges of nursing, human ecology, business, and education.

The analysis also shows that students in colleges that scored highest were mostly upper level graduate students. Accordingly, undergraduate students dominated the lowest scoring colleges. These research findings suggest a correlation between academic level and environmental knowledge.

ACKNOWLEDGEMENTS

Firstly, I would like to thank Kristy VanMarter for her consistent willingness to listen and help me with data analysis and formatting. Her support and interest in my work were an inspiration and motivation for its completion.

I would also like to thank my family, friends and co-workers for their gentle encouragement and faith in me. I would especially like to thank my brother Ryan for always being there when I needed him.

My sincere thanks go to Brandon VanMarter, my best friend, my love, and my biggest fan. Without his unwavering love, patience and support, this thesis would not exist.

Lastly, to my parents, thank you for your undying encouragement, advice, confidence, and inspiration. For without your unconditional support and pride in me this thesis would have not been possible. This thesis is dedicated to you.

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CHAPTER ONE

INTRODUCTION OF RESEARCH TOPIC

Introduction

An educated citizenry has the power to make good environmental decisions. Knowledge is an essential component of any successful decision-making process. Given these sentiments, one could deduce that in the absence of knowledge there exists a lack of power for one to make good decisions. This may explain why there is a correlation between level of knowledge (i.e. educational attainment) and the degree of responsibility (i.e. power) in today's America. The correlation between knowledge and power provides a rationale and basis for environmental education. As time goes by, new generations become responsible for making decisions that will affect those in future generations as well as decisions addressing issues and problems left by those that came before. For this reason, it is imperative that decision makers of the future have a working knowledge of the environment so that they are adequately prepared to make decisions that will preserve and protect it.

The concept of environmental education is largely a result of the environmental movement of the early 1970's. The environmental movement can be attributed to an increase in environmental information coupled with a change in social values (Swan 1971). The American public was bombarded with new information and evidence of environmental degradation beginning with the release of Rachel Carson's *Silent Spring* in 1962 and followed by events such as

the explosion of an oil well off the coast of Santa Barbara and the fire on the Cuyahoga River in Cleveland in 1969. These events in conjunction with the social controversies of the times, led to a public out-cry for environmental protection.

In 1970, the nation celebrated its first Earth Day. National recognition of the importance of a clean and healthy environment led in turn to support for efforts to promote environmental education. People began to realize that individual actions, values and opinions were largely to blame for the state of the environment (Stapp 1971; Swan 1971). Researchers embraced education as an important way to bring about the social changes necessary to resolve and prevent environmental problems. It was believed that the dissemination of environmental information could increase environmental knowledge levels. Researchers assumed that knowledge was crucial to change attitudes and that a new attitude was necessary to alter the actions and policy decisions impacting the environment (Ramsey and Rickson 1976).

The concept of environmental education was developed and defined by William B. Stapp and his colleagues during a graduate seminar at the University of Michigan in 1969 and published in the first issue of the Journal of Environmental Education in 1969. Since then, the concept of environmental education has been widely embraced, both nationally and internationally. In 1973, the United Nations Educational, Scientific, and Cultural Organization [UNESCO], proposed a global framework and goal statement for environmental education, referred to as the Belgrade Charter (United Nations Educational

Scientific and Cultural Organization 1975). Two years later, during an environmental education workshop, UNESCO produced a set of goals for environmental education entitled the Tbilisi Report (United Nations Educational Scientific and Cultural Organization 1978).

In response to the framework and goals established by UNESCO, the North American Association for Environmental Education [NAAEE] developed a revised definition of environmental education in 1983 (North American Association for Environmental Education 1999). The United States formally embraced environmental education in 1990 when Congress passed the National Environmental Education Act (Senate 1990). In 1992, the United States again supported the importance of environmental education when they, along with Mexico and Canada signed the Memorandum of Understanding (MOU) on Environmental Education (U.S. Environmental Protection Agency 1992).

Over the past 35 years, the United States has been committed both publicly and politically to improving the environmental knowledge of its citizenry through education. Despite this commitment and the efforts of government, schools, and other organizations, research indicates that the American public still lacks basic environmental knowledge. Based on information gathered by the National Environmental Education and Training Foundation [NEETF] and Roper Starch Worldwide, "two thirds of adult Americans consistently fail simple tests of environmental knowledge" (National Environmental Education and Training Foundation 2002). Considering the advancements and attention given to environmental education over the past four decades this is troubling.

Traditionally, the focus of environmental education efforts has been on youth. Most environmental education programs and organizations focus their efforts on children in grades K-12. When the concept of environmental education was first developed, research indicated that childhood was the critical time to develop a persons' sense of citizen responsibility (Hess and Torney 1967). Researchers recognized that youth grow up to become responsible for making decisions in the future, and that changing social values may result from educating and increasing the knowledge of children (Stapp 1971; Swan 1971). Today, thirty million children in the United States receive formal education on the environment each year (National Environmental Education and Training Foundation 2002). However, studies show that the majority of U.S. high school students appear to lack a basic understanding of the environment (Blum 1987; Barrow and Morrisey 1988-1989; Brody et al. 1988-1989; Gambro and Switzky 1996; Peri 1996; Gambro and Switzky 1999; Greene et al. 2000; Donovan 2001). In a 1996 national study of high school students, John Gambro and Harvey Switzky found that twelfth grade students averaged a score of only 54.3% correct answers of seven questions related to environmental knowledge (mean=3.80, sd=1.74).

With an increasing number of high school graduates choosing to attend degree-granting institutions, colleges and universities may be able to take a leading role in educating their students on the environment. The need for increased environmental education in college curricula was specifically addressed in Agenda 21 adopted at the 1992 United Nations Earth Summit

(Wilke 1995). It remains to be seen whether colleges and universities in the United States have begun to incorporate and increase environmental education of their students. However, studies do show that environmental knowledge is correlated with level of education (Maloney and Ward 1973; Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Arcury 1990; Arcury and Christianson 1993; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998, 1999, 2000; Tikka et al. 2000). Therefore, the universities and colleges may positively impact students' environmental education.

Research has shown that the higher a person's level of educational attainment, the more knowledgeable they are about the environment. Arcury and Christianson (1993) found environmental knowledge to be directly correlated to level of education ($F=48.240$, $p<0.01$) in a study of Kentucky residents over the age 18. However, this research does not indicate absolute levels of knowledge and, in some instances can be misleading. For example, in a national survey conducted on environmental education in 2000, respondents with a college education scored higher than those with only a high school education. What is misleading about these results is that while respondents with a college education may have scored higher, than high school graduates on average, they only received a borderline pass / fail (C- / D+) grade (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000).

Statement of the Problem

Researchers have examined environmental knowledge among college students in the United States (Synodinos 1990; Shetzer et al. 1991; Benton 1993, 1994; Dunaway 1999). The research has focused on comparisons of knowledge levels among students having different majors or areas of study. These studies have examined the levels of environmental knowledge among students studying business as compared to non-business majors (Synodinos 1990; Shetzer et al. 1991; Benton 1993, 1994) and to a comparison of law students at two law schools in Kentucky (Dunaway 1999). Therefore, the reported research studies the levels of environmental knowledge of undergraduate, graduate and professional students at Michigan State University.

Research Objectives and Hypotheses

The reported research compares the level of environmental knowledge of students at Michigan State University to national averages as well as investigates the relationship between students' environmental knowledge and the college in which they are majoring. More specifically, the objectives of this study are to assess how knowledgeable students at Michigan State University are about environmental issues and to examine how their knowledge level varies depending on the college within which they are majoring. For analysis purposes, the following hypothesis will be tested.

Hypothesis One

H_0 : $K_{MSU} = K_{NAT}$

H_1 : $K_{MSU} > K_{NAT}$

Where K_{MSU} represents the percent passing scores for Michigan State University students, and K_{NAT} represents percent passing scores for the National sample. The percent passing scores for the MSU students are expected to be higher than those of the National sample. This first hypothesis predicts that environmental knowledge of MSU students will exceed the environmental knowledge of the national sample. This hypothesis is based on research indicating that knowledge levels increase with level of educational attainment (Maloney and Ward 1973; Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Arcury 1990; Miller 1990; Arcury and Christianson 1993; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000).

Hypothesis Two

H_0 : $K_{C1} = K_{C2} = K_{C3} = K_{C4} = K_{C5} = K_{C6} = K_{C7} = K_{C8}$

$= K_{C9} = K_{C10} = K_{C11} = K_{C12} = K_{C13} = K_{C14} = K_{C15}$

H_1 : **Not all K_{Ci} (i = 1, ..., 15) are equal**

Where K_{C1} through K_{C15} represent the mean knowledge scores for the 15 colleges within Michigan State University. It is expected that the environmental knowledge of Michigan State University students will differ depending on the

college within which they are majoring. The second hypothesis is based on two assumptions justified in the next chapter of the reported research (Chapter Two). First, research indicates that environmental and ecological literacy instruction is not a requirement at the majority of degree granting institutions in the United States (Wolfe 2001) and that without such a requirement, students are unlikely to be exposed to environmental education unless they major or minor in an environmental program (Coppola 1999). Second, a study performed in Finland revealed differences in environmental knowledge scores of students enrolled in various colleges (Tikka et al. 2000). This study found that students enrolled in environmental colleges such as forestry and biology scored higher than students studying in colleges related to health care, teaching and commercial studies (Tikka et al. 2000).

Significance of the Study

This study is significant for several reasons. First, it will provide data on a specific population in the United States that may have considerable influence on the future of our environment. This research will contribute to our understanding about where we may wish to concentrate future environmental education efforts.

Second, this study will help evaluate the level of environmental knowledge of students within the various colleges of the university. Other research has assessed the knowledge of students, by making comparisons between broad categories (e.g. business vs. non-business students; law school vs. law school).

No previous studies were found representing a comparison of all students at a single university.

Third, this study draws from previous research and combines in a single study, all of the students and colleges within one specific university. Doing so enables comparative analysis between the students and colleges of Michigan State University with information obtained at other universities where prior studies have been conducted. The results will improve our knowledge base about how universities are reacting to the need for environmental education.

Fourth and finally, the current study will assist university leaders, department heads, educational associations, political leaders, environmental groups and others to make more informed decisions about helping institutions of higher education contribute to and help create an environmentally literate citizenry.

Organization of the Study

This thesis is organized into five chapters- Introduction, Literature Review, Methods, Analysis, and Conclusions. Chapter two will discuss and review the literature as it applies to environmental knowledge research. The third chapter will focus on the research design including methods, study population, sampling, and data collection. Chapter four will present and analyze the data and Chapter five will contain the conclusions, limitations, and recommendations for further study.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

Public concern for the environment can be traced back to the origins of the environmental movement. Since the late 1960's, researchers, politicians, private organizations, and the public at large have focused on preserving and protecting the environment. For many, this focus has revolved around the concept of environmental education. For the purposes of this paper, environmental education is defined as:

> Education aimed at producing a citizenry that is knowledgeable concerning the bio-physical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution (Stapp 1969).

As evidenced in this definition, knowledge is an essential component of producing an educated public willing and capable of solving environmental problems. As a result, much environmental education research centers on measures of and improvements to individuals' environmental knowledge. This chapter presents a review of some previous research on environmental education and environmental knowledge.

Environmental Knowledge

Existing research on environmental knowledge indicates a troubling absence of environmental knowledge among both student groups and adult populations (Council on Environmental Quality 1980; Arcury and Johnson 1987; Blum 1987;

Barrow and Morrisey 1988-1989; Brody et al. 1988-1989; Arcury 1990; Miller 1990; Gambro and Switzky 1996; Peri 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998; Gambro and Switzky 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999; Greene et al. 2000; National Environmental Education and Training Foundation and Roper Starch Worldwide 2000; Donovan 2001). For example, Gambro and Switzky (1999) found low levels of environmental knowledge among twelfth grade high school students in the United States. Likewise, in a national probability sample, Miller (1990) found that adult Americans lacked a basic understanding of the hole in the ozone layer and acid rain. Recognizing the deficiencies of the public's environmental knowledge, researchers have looked into the relationships that impact and are associated with acquisition, retention, and presence of environmental knowledge.

A number of researchers have identified a correlation between environmental attitudes and environmental knowledge (Fortner and Mayer 1983; Fortner and Mayer 1988; Arcury 1990; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Bradley et al. 1999; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000). This research has shown that those who possess a high level of environmental knowledge also tend to possess positive attitudes towards the environment. The relationship between environmental attitudes and knowledge has been found in studies performed on different age groups in different countries. Fortner and

Mayer (1983, 1988) found that students who scored high on knowledge of the oceans and the Great Lakes also exhibited positive attitudes towards the oceans and the Great Lakes. In Texas, those high school students that scored highest on environmental knowledge were also found to have favorable attitudes regarding the environment (Bradley et al. 1999). In two studies of college students, one in the United States and one in Finland, higher environmental knowledge levels were strongly correlated to positive environmental attitudes (Dunaway 1999; Tikka et al. 2000). Similar results correlating positive environmental attitudes with high levels of environmental knowledge were obtained in research on adult populations in the United States and in Taiwan (Arcury 1990; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998, 1999, 2000).

Another notable, positive relationship that has been found to be associated with environmental knowledge is respondents' environmental activity. A positive correlation has been documented between individuals' level of environmental knowledge and their pro-environmental behaviors (Hungerford and Volk 1990; Zimmerman 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000). In a Finnish study of university students researchers found that students who participated in environmental activities such as fishing and recycling scored higher on environmental knowledge items (r_s=0.378, df=462, $p<.001$) when compared to students who

were not involved in environmental activities (Tikka et al. 2000). Additionally, research has demonstrated that the relationship between the two is more complex than traditionally thought (Hungerford and Volk 1990; Zimmerman 1996). As Harold Hungerford and Trudi Volk (1990) suggest, the relationship between environmental knowledge and environmental behavior is very complex and involves many variables working together. They argue that knowledge alone does not change behaviors. They see knowledge as an essential component in encouraging ownership and empowerment, which in turn leads to behavioral changes. Similarly, Zimmerman (1996) suggests that not only must there exist a general knowledge, there must also be motivation to change and an understanding of what needs to be done to make that change.

Previous research has also identified a number of demographic characteristics that are related to individuals' environmental knowledge. The most widely researched demographic characteristic in relation to environmental knowledge appears to be respondents' gender. Research shows that males, by a margin of 2:1, have higher levels of environmental knowledge than females (Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Blum 1987; Fortner and Mayer 1988; Barrow and Morrisey 1988-1989; Arcury 1990; Miller 1990; Arcury and Christianson 1993; Benton 1994; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Gambro and Switzky 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000). In contrast, it seems that women have been found to exhibit more concern and have more

positive attitudes toward the environment than their male counterparts (Benton 1994; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998, 1999, 2000; Tikka et al. 2000).

Researchers have also identified a correlation between age and environmental knowledge (Arcury et al. 1987; Arcury 1990; Arcury and Christianson 1993; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998, 1999, 2000; Tikka et al. 2000). For example, older college students in Finland, possessed more environmental knowledge ($F=8.81$, $df=2$, $p<0.01$) than their younger peers (Tikka et al. 2000). In the United States, Thomas Arcury and his colleagues (Arcury et al. 1987; Arcury 1990; Arcury and Christianson 1993) found a statewide correlation between age and levels of environmental knowledge in Kentucky indicating that environmental knowledge levels increase with age in adults over age 18. In four studies commissioned by the National Environmental Education and Training Foundation [NEETF] and performed by Roper Starch Worldwide, environmental knowledge levels were found highest among middle age (35-54) Americans (National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998, 1999, 2000).

Increased environmental knowledge levels have also been found to be correlated with educational attainment. Researchers have reported a relationship between respondents' level of education and their amount of environmental knowledge (Maloney and Ward 1973; Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Arcury 1990; Miller 1990; Arcury and

Christianson 1993; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000). In a study of community leaders in Taiwan, researchers found that education level was the best predictor of environmental knowledge (r_2=.1162, F=21.70, p<0.01). This positive relationship between environmental knowledge and education helps to sustain support for United States environmental education efforts (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000).

Environmental Knowledge and the University

Although many studies concerning environmental education have taken place at universities, much has been written about the absence of, and discounting the importance of, environmental education at institutions of higher learning (Orr 1995; Wilke 1995; Wilshire 1995). David Orr (1995) and Bruce Wilshire (1995) both point to the discipline-based structure of colleges and universities as a dominant reason for an apparent inability to respond to the ecological crises. They assert that the fragmentation caused by disciplines within colleges and universities precludes students from learning how they fit in with the natural world. Likewise, faculty members (professors) have become specialized professionals with their primary focus on research and publication rather than contributing to community and society (Orr 1995). At a larger scale, colleges and

universities also seem to lack the leadership necessary to become good environmental educators (Orr 1995).

It has been suggested that institutions of higher education incorporate environmental and ecological literacy instruction into their general education curriculum (Orr 1995; Wilke 1995; Wolfe 2001). Currently, fewer than 12 percent of four-year institutions of higher learning in the United States have environmental and ecological learning as a requirement (Wolfe 2001). On a positive note, over half the four-year colleges and universities in the United States do have a course in environmental literacy within their general education curriculum (Wolfe 2001). Without a general education requirement for environmental literacy, research indicates that students are unlikely to be exposed to environmental education unless they major or minor in an environmental program (Coppola 1999). Similarly, the literature indicates an absence of environmental education efforts in business school programs (Jubeir 1995; Hoffman 1999), traditional engineering programs (Dorweiler and Yakhou 1998) and in preservice teacher education programs (McKeown-Ice 2000).

The effectiveness of environmental education within different programs and fields of study at institutions of higher learning has also been examined (Synodinos 1990; Benton 1993, 1994; Tikka et al. 2000; Hodgkinson and Innes 2001). This research typically has focused on differences in environmental knowledge, attitudes and actions of students within different disciplines. For example, students in biology, forestry and history were found to be most environmentally knowledgeable at Finnish Universities while students studying in

the college of health care, the preschool teacher training institute and the commercial college scored lowest (Tikka et al. 2000). In another study, business students were found to be less environmentally knowledgeable when compared to students in environmental psychology and the general public (Synodinos 1990). However, a study of undergraduate business students found no statistically significant difference in environmental knowledge levels as compared to non-business undergraduates (Benton 1994).

Reported research on environmental attitudes among college and university students indicates that such attitudes vary depending on students' fields of study (Synodinos 1990; Benton 1994; Tikka et al. 2000; Hodgkinson and Innes 2001). Research of environmental attitudes of students at an Australian university found that students in disciplines studying the environment, biology, sociology, the humanities, and psychology had the most positive environmental attitudes while students studying veterinary medicine, law, commerce, and computer disciplines had the least positive environmental attitudes ($F=3.3$, $p<0.01$) (Hodgkinson and Innes 2001).

There is also research on the relationship between students' field of study and their environmental action levels (Synodinos 1990; Benton 1994; Tikka et al. 2000). Examples of environmental action used in the research include using and/or purchasing environmentally friendly products, recycling, contacting a congressman concerning environmental problems, or participating in outdoor activities such as camping, hiking or fishing. Benton (1994) found students in schools of business to be less involved in environmental activities as compared

to students in non-business disciplines. In Finland, students in the colleges of biology, forestry, health care and social policy were found to have participated in the most environmental activities while the students there studying in technical, economic, statistical and commercial colleges were the least environmentally active ($F=9.15$, $df=16$, $p<0.01$) (Tikka et al. 2000).

Summary and Conclusions

As the review of the literature illustrates, there has been a foundation of research on the relationship of environmental education, environmental attitudes, and environmental activities of university students as well as the general public. The literature seems to support several general notions and researchable questions concerning environmental education:

- The American public lacks a basic knowledge of the environment

  Supported by: (Council on Environmental Quality 1980; Arcury and Johnson 1987; Blum 1987; Barrow and Morrisey 1988-1989; Brody et al. 1988-1989; Arcury 1990; Miller 1990; Gambro and Switzky 1996; Peri 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998; Gambro and Switzky 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999; Greene et al. 2000; National Environmental Education and Training Foundation and Roper Starch Worldwide 2000; Donovan 2001).

- A positive correlation between environmental knowledge and environmental attitude.

  Supported by: (Fortner and Mayer 1983; Fortner and Mayer 1988; Arcury 1990; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Bradley et al. 1999; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000).

- A positive correlation between environmental knowledge and environmental activities.

  Supported by: (Hungerford and Volk 1990; Zimmerman 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000).

- Men have more environmental knowledge than women.

  Supported by: (Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Blum 1987; Fortner and Mayer 1988; Barrow and Morrisey 1988-1989; Arcury 1990; Miller 1990; Arcury and Christianson 1993; Benton 1994; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Gambro and Switzky 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000).

- A positive correlation between age and environmental knowledge.

  Supported by: (Arcury et al. 1987; Arcury 1990; Arcury and Christianson 1993; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998, 1999, 2000; Tikka et al. 2000).

- A positive correlation between educational attainment and environmental knowledge.

  Supported by: (Maloney and Ward 1973; Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Arcury 1990; Miller 1990; Arcury and Christianson 1993; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000).

- A lack of environmental education at institutions of higher learning.

  Supported by: (Orr 1995; Wilke 1995; Wilshire 1995; Wolfe 2001).

- University student knowledge, attitudes, and behaviors regarding the environment vary depending on field of study.

  Supported by: (Synodinos 1990; Benton 1993, 1994; Tikka et al. 2000; Hodgkinson and Innes 2001).

Many of these notions, especially those concerning environmental knowledge among university students and their fields of study, will be examined

in the reported research. The research uses a university-wide survey, quantitative data collection and analysis, to examine a range of hypotheses pertinent to the literature. The next chapter explains and discusses the research design and methods used in the reported research.

CHAPTER THREE

RESEARCH DESIGN AND METHODS

Introduction

This chapter presents and explains the methods used to achieve the stated research objectives, specifically an analysis of university students' environmental knowledge and related factors. This research is based on the use of survey questionnaires to collect data from Michigan State University [MSU] students. The student survey data were analyzed using generally accepted statistical methods.

The survey was distributed to respondents using a mixed methods approach and following a Dillman "Tailored Design" method (2000). The survey project conformed to the research requirements of the MSU University Committee on Research Involving Human Subjects [UCRIHS] and received UCRIHS approval on March 19, 2001 (see **Appendix A**). Subsequent modifications to the survey instrument as well as pre-testing and implementation procedures were reviewed and approved by UCRIHS. This chapter describes the study's instrument design, subject population and sample selection, implementation methods, and data analysis procedures.

The Instrument

The reported research is based on data collected using a survey questionnaire developed as part of the Michigan State University sponsored Watershed Action

Through Education and Research project [MSU-WATER] (Witter and Kline-Robach 2001). The survey questionnaire was designed and administered by the MSU-WATER Social Assessment Sub-Committee [SASC]. The SASC was comprised of Dr. Michael D. Kaplowitz, Dr. Ralph Levine, Dr. Geoffrey Habron, Doctoral Candidate Timothy Hadlock, and myself. For a short while, Dr. Craig Harris was also a member of the SASC. The purpose of the survey instrument was the assessment of university student stakeholders' knowledge, use, and attitudes regarding the Red Cedar River (and its watershed) on the campus of Michigan State University. The survey questionnaire was implemented using both hardcopy and web-based versions of the instrument. The data gathered from the survey will be used to help MSU comply with Phase II of the Federal Clean Water Act and create a campus-wide watershed management plan for the Red Cedar River.

The majority of the survey questions were designed by the committee using an iterative approach and are specific to Michigan State University and the Red Cedar River. However, the twelve "environmental knowledge questions" were included in the survey questionnaire to support the reported investigation into students' general environmental education. Specifically, the researcher helped identify and incorporate twelve questions into the MSU-WATER Student Survey from the National Environmental Education and Training Foundation [NEETF] and Roper Starch Worldwide annual survey of Adult Americans. (National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 2000).

The 12 environmental knowledge questions used in this study were originally designed by NEETF and Roper Starch for their 1997 survey of adult Americans (National Environmental Education and Training Foundation and Roper Starch Worldwide 1997). NEETF and Roper report having initially created more than 50 environmental knowledge questions for possible use in their survey questionnaire. They report pretesting potential questions and narrowing down potential items to the 12 questions used in there 1997 study. The 1997 pretesting involved surveying environmental educators on what they believed constituted basic environmental knowledge, examining publicly accessible environmental education in the media, and focus group interviews of people in assorted age groups and having different backgrounds (National Environmental Education and Training Foundation and Roper Starch Worldwide 1997).

The NEETF and Roper Starch Worldwide environmental knowledge questions were intended to measure only a very basic knowledge of the environment (National Environmental Education and Training Foundation and Roper Starch Worldwide 1997). Select questions from the 1997 survey were repeated in the 1998 and 1999 versions of the NEETF and Roper Starch surveys and the entire set of questions were repeated in the year 2000 survey. The reported research will compare the results of the year 2000 NEETF and Roper Starch Worldwide annual survey of adult Americans to the students at Michigan State University.

The MSU-WATER survey questionnaire consisted of nine major content sections. The first seven sections deal specifically with the Red Cedar River and

Michigan State University. Most of these questions use a Likert-like scale with response choices presented in a positive to negative direction. The eighth section inquires about respondents' environmental knowledge using close-ended questions with five possible choices. The knowledge item answer choices were designed to have one correct answer choice, one conceivable but incorrect choice, and two implausible choices (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000). Each item also has a "don't know" answer choice. The final section addresses respondents' demographics (See **Appendix B** for a copy of the survey document).

The survey questionnaire was pre-tested and revised during June and July of 2001. Research assistants (myself included) used a capture sample approach to recruit respondents to pretest and help evaluate draft versions of the questionnaire. The pretesting utilized a one-on-one cognitive approach with retrospective think alouds (Kaplowitz et al. In Press). Potential respondents (students) were randomly approached at different locations on campus and asked if they would be willing to take a survey and discuss with the research assistant (moderators) their thoughts and comments. Potential participants were also told that they would be paid $10.00 for their help. After completing an informed consent form and the required university payment form, participants took the self-administered questionnaire and then answered several questions asked by the moderator. The pretest moderators recorded the time taken by participants to complete the survey, any questions asked by the respondents, and the subjects' answers to specific probes about the instrument asked by the

moderator. The script used during the pretesting sessions as well as the consent form is included in **Appendix C.** A total of 14 pretesting sessions were conducted. Completion of the web instrument or the hardcopy questionnaire pretest took participants about 15 minutes. Validity of the survey instrument was established through analysis of cognitive interviews and the use of confirmatory factor analysis.

Population and Sample

The population for this study was MSU students. There are approximately 40,000 undergraduate, graduate, and professional students that attend MSU. Because the study was able to use both self-administered mail surveys and self-administered web-based surveys, it was estimated that the project could survey about 2,600 students using hardcopy survey questionnaires and about 17,000 students via e-mail and the web-based self-administered survey questionnaire. The hard copy version of the survey was to have a smaller sample size as compared to the Internet samples due to the substantially higher costs associated with the production and distribution of the hard copy version.
A stratified, random sample of 19,890 students was chosen in a single stage. The researchers requested five mailing lists of MSU students each to be independent, randomly selected, and stratified by academic level – one for the hardcopy survey treatment and four mailing lists for four different e-mail/web survey implementation modes. The hardcopy survey sample consisted of 2,594 students stratified across the seven academic levels (freshmen, sophomore,

junior, senior, masters, professional, and doctoral). The Internet survey sample consisted of four sub-samples totaling 17,296 students stratified by academic level (4341, 4342, 4342, and 4271).

The sample request was approved and created by the MSU Office of the Registrar in September 2001. As mentioned, the academic levels used for sample stratification were: freshmen, sophomores, juniors, seniors, masters, professional, and doctoral students. The sample mailing lists were stratified in this manner to provide a representative sample of students by academic level at the university. The sample was selected and stratified in five groups to ensure an adequate number of respondents for each implementation mode. Within each mode of survey distribution, there are proportionate numbers of student types. The overall sample size was determined by assuming that a ten percent (10%) response rate to the survey would allow for viable statistical analysis. Previous web-based surveys of students at MSU achieved about a ten percent response rate (Mertig and Link 2001).

Implementation

All students at MSU have an e-mail account and free access to the Internet. Furthermore, MSU students are expected to use the Internet to communicate with instructors and administrators, register for classes, and participate in their courses. The questionnaire was to be implemented using a hardcopy mailed to a random sample of students and a web-based questionnaire e-mailed to another random sample of students. The web-based questionnaire

was virtually an exact copy of the written instrument except that students scrolled down and "clicked" to fill in their responses to the closed-ended questions instead of turning pages and using a pencil or pen to fill in ScanTron ® "response bubbles".

During November 2001, a total of 19,890 MSU students received an MSU Watershed survey by either e-mail or U.S. mail. As mentioned, recipients were divided into five groups differentiated by the survey's distribution mode. Within constraints imposed by the university (e.g., strict limit of only e-mail contact allowed) and the experimental design (e.g., maximum of four contacts), the researchers adopted a Dillman (2000) "Tailored Design" approach to implement their survey. Group 1 (mail, N=2594) received four contacts: a preliminary postcard, a hardcopy survey with cover letter explaining the purpose of the study, a follow-up postcard, and a second hardcopy survey sent to all non-respondents to the first survey. Group 2 (e-mail, N=4341) received only one contact: an e-mail containing the same explanation of purpose as Group 1's letter and a hyperlink to the web version of the survey. Group 3 (postcard/e-mail, N=4342) received two contacts: a preliminary postcard and an e-mail (as described above). Group 4 (e-mail/postcard, N=4342) received two contacts: first the e-mail and then a follow up postcard. Group 5 (postcard/e-mail/postcard, N=4271) received three contacts: the preliminary postcard, the e-mail, and a follow up postcard. The different methods of distribution were chosen for comparative analysis purposes to by analyzed by other researchers. (See **Table 3.1**)

All participants received a cover letter, either hardcopy or e-mail, that provided the potential respondents with information regarding the purpose of the survey and their rights as a study participant. The cover letter explained that respondents' privacy would be protected and it explained that completing and returning the survey indicated their consent to participate. The cover letter also provided the potential respondents with information regarding the length of time it should take to complete the survey as well as their eligibility to participate in a random drawing for a gift certificate. The cover letter also provided the recipients with a name and contact number if they had any questions or concerns about participation in the survey (See **Appendix D** for a copy of the cover letter).

Table 3.1
Contact Methods

GROUP	NUMBER OF STUDENTS	METHOD OF CONTACTS
1	2594	Postcard, Hardcopy Survey, Postcard, Replacement Survey
2	4341	E-mail
3	4342	Postcard, E-mail
4	4342	E-mail, Postcard
5	4271	Postcard, E-mail, Postcard

Students receiving an e-mail/web-version of the survey were asked to participate by logging in to a website. The e-mails and postcards for both the hardcopy and web-based versions are attached as **Appendix E**. The differences among the different groups in regards to response rates will not be analyzed in the reported research. Likewise, the substantive watershed data and results of the survey are beyond the scope of this thesis. This thesis treats the data from

all five treatments as aggregate data and focuses on the research questions concerning students' environmental knowledge.

Data Analysis

Although this research is limited to specific components of the survey instrument, the researcher will analyze some responses to questions from other sections of the instrument (e.g. demographics). Similarly, overall response rates for the survey instrument will be reported while item non-response rates for the environmental knowledge questions will also be examined. To analyze the survey data and test the research hypotheses, the researcher used the student version of the Statistical Package for the Social Sciences [SPSS] software.

Respondent results for both the hard copy and web-based versions of the survey instrument were coded and brought into the SPSS software program for data analysis. The hardcopy ScanTron ® surveys were processed by the MSU Electronic Scoring Office. The Scoring Office produced a data file with numbers correlating to respondent answer choices. Web-based survey data were downloaded from the web with responses displayed in text format. For each question and respondent, individual answer choices were assigned a numeric value and recoded to reflect a numeric rather than the text value.

The research is guided by specific research questions and testable hypotheses. Specifically, the proposed research addresses, among others, the following:

Research Question 1: **How knowledgeable are Michigan State University students on environmental issues and problems?**

Hypothesis One: H_0 : $K_{MSU} = K_{NAT}$

H_1 : $K_{MSU} > K_{NAT}$

Where K_{MSU} represents the percent passing scores for Michigan State University students, and K_{NAT} represents percent passing scores for the National sample. The percent passing scores for the MSU students are expected to be higher than those of the National sample. This first hypothesis predicts that environmental knowledge of MSU students will exceed the environmental knowledge of the national sample. This hypothesis is based on research indicating that knowledge levels increase with level of educational attainment (Maloney and Ward 1973; Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Arcury 1990; Miller 1990; Arcury and Christianson 1993; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000).

Research Question 2: **How does environmental knowledge of Michigan State University students differ depending on the students' college of major study?**

Hypothesis Two: H_0 : $K_{C1} = K_{C2} = K_{C3} = K_{C4} = K_{C5} = K_{C6} = K_{C7} = K_{C8} = K_{C9} = K_{C10} = K_{C11} = K_{C12} = K_{C13} = K_{C14} = K_{C15}$

H_1 : **Not all K_{Ci} (i = 1, ..., 15) are equal**

Where K_{C1} through K_{C15} represent the mean knowledge scores for the 15 colleges within Michigan State University. It is expected that the environmental knowledge of Michigan State University students will differ depending on the college within which they are majoring. The second hypothesis is based on two assumptions. First, research indicates that environmental and ecological literacy instruction is not a requirement at the majority of degree granting institutions in the United States (Wolfe 2001) and that without such a requirement, students are unlikely to be exposed to environmental education unless they major or minor in an environmental program (Coppola 1999). Second, a study performed in Finland revealed differences in environmental knowledge scores of students enrolled in various colleges (Tikka et al. 2000). This study found that students enrolled in environmental colleges such as forestry and biology scored higher than students studying in colleges related to health care, teaching and commercial studies (Tikka et al. 2000).

For the purposes of data analysis and to accurately analyze the environmental knowledge of MSU students when compared to the National sample, the knowledge scores presented in the reported research were calculated based on the grading scale utilized by NEETF and Roper Starch

Worldwide in the 2000 national survey of adult Americans (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000). The grading scale is presented in **Table 3.2**. The NEETF and Roper Starch Worldwide survey calculated letter grades based on respondents' percentage of correct answers and presented the grades in a report card. The NEETF and Roper survey categorized scores of greater that 70% (grades A, B and C) as passing scores and those below 69% (grades D or F) as failing (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000).

Table 3.2
NEETF and Roper Starch Worldwide National Survey Grading Scale as Applied to the Reported Research

Letter Grade	Number of Questions Answered Correctly	Percentage Score	Pass / Fail Determination
A	10 or 11	90% – 100%	Pass
B	9	80% – 89%	Pass
C	8	70% – 79%	Pass
D	7	60% – 69%	Fail
F	6 or fewer	59% or less	Fail

The statistical techniques used for the quantitative data analysis and hypothesis testing include: frequencies, descriptive statistics, Chi-Square, and analysis of variance [ANOVA]. Frequencies are used to analyze the demographic characteristics of the sample, the item non-response rates, the frequency of responses on each knowledge item, and the frequency of respondents within each academic college. Chi-Square analysis is employed to check for significant differences of the responses on the knowledge items between MSU populations and the national population. Descriptive statistics

(mean and standard deviation) are used to analyze overall item non-response, general knowledge scores on the knowledge items, and differences in number of items answered correctly for each college. The oneway analysis of variance [ANOVA] test is used to determine whether or not there exists a difference in environmental knowledge among the varying colleges. The results of these analyses are presented in the next chapter in both text as well as tabular form.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

Introduction

This chapter presents and analyzes the results of the MSU-WATER survey questionnaire as they relate to the research hypotheses. The first section of this chapter provides an overview of the sample characteristics including response rates and demographics. The second section is concerned with the testing of research hypotheses. In both sections, the quantitative data are statistically analyzed using one or more of the following techniques: Frequencies and percentages; Mean and standard deviation; Chi-Square; and Analysis of Variance (ANOVA).

Sample Characteristics

The total sample consists of 6004 student respondents. This number of respondents represents an overall 30 percent response rate (RR6,maximum response rate according to AAPOR 2000). The distribution of demographic characteristics of the sample is presented in **Table 4.1**. The original random sample was stratified across seven academic levels: freshman, sophomore, junior, senior, masters, professional, and doctoral. All levels of stratification were represented in the sample with senior (18.1%) and masters' (16.8%) students responding the most frequently and freshman (12.8%) and professional (4.2%)

students responding the least frequently. A total of 82 (1.4%) students failed to indicate their academic level.

Table 4.1
Sample Characteristics – Demographics
(presented in descending order)

Demographic Characteristics	Level	Number of Responses	Percent of Responses Received
Academic Level	Senior	1089	18.1
	Master's	1008	16.8
	Junior	985	16.4
	Doctoral	987	16.4
	Sophomore	834	13.9
	Freshman	766	12.8
	Professional	253	4.2
	Missing	82	1.4
Age	20-29	4165	69.4
	30-39	742	12.4
	Under 20	539	9.0
	40-49	314	1.5
	50-59	104	1.4
	Over 60	20	0.3
	Missing	120	2.0
Gender	Female	3519	58.6
	Male	2404	40.0
	Missing	81	1.3
College Major	Natural Science	813	13.5
	Social Science	744	12.4
	Arts and Letters	714	11.9
	Business	663	11.0
	Ag. & Nat. Resources	624	10.4
	Education	578	9.6
	Engineering	577	9.6
	Don't Know	255	4.3
	Veterinary Medicine	233	3.9
	Human Ecology	226	3.8
	Osteopathic Medicine	118	2.0
	Human Medicine	115	1.9
	James Madison	110	1.8
	Nursing	80	1.3
	Detroit Law	3	0.0
	Missing	151	2.5

The students' ages ranged from 18 to 73. The dominant age group was students' between the ages of 20 and 29 (69.4%). The distribution of gender was 58.6% female and 40% male. There were 81 (1.3%) students who did not indicate their gender.

The College of Natural Science had the most respondents with 813 students constituting 13.5% of the sample. The Detroit College of Law had the least number of respondents (N=3) and this small number of respondents excluded the College of Law from much of the college level statistical analysis. It should be noted here that the College of Communication Arts and Sciences was inadvertently left off of the answer choices for this question. In the additional comments section of the survey, a number of respondents indicated their non-response to this item as a result of the missing college. This error may have contributed to the large number of missing responses to this item (N=151).

Knowledge Items

The survey document consisted of 12 questions that specifically related to environmental knowledge (see **Appendix B - Items H1-H12**). The correct answers to the knowledge items are presented in **Appendix F**. The first question asked the student to indicate their perceived knowledge of environmental issues and problems. The remaining items asked a specific question and offered 5 answer choices, 1 of which was correct. As discussed above, these questions were taken from the National Environmental Education and Training Foundation [NEETF] and Roper Starch Worldwide annual surveys which have been used

extensively in national studies. For the purpose of the reported analysis, the answer choices were converted to either correct or incorrect to indicate pass or fail for each item. The overall non-response rate for the 12 items averaged 1.31%. That is, on average, more than 98% of respondents answered the knowledge questions. The non-response rates for each question are presented in **Table 4.2**. The question most frequently left blank was question 10 and question number 4 was the question least likely to be skipped.

Table 4.2
Knowledge Item Non-Response

Question	Knowledge Item	N	%
1	Perceived Knowledge	71	1.2
2	Biodiversity	73	1.2
3	Carbon Monoxide	74	1.2
4	Electricity	66	1.1
5	Water Pollution	86	1.4
6	Renewable Resource	79	1.3
7	Ozone Protection	89	1.5
8	Garbage	74	1.2
9	EPA	85	1.4
10	Hazardous Waste	94	1.6
11	Animal Extinction	81	1.3
12	Nuclear Waste	77	1.3
Mean		79	1.3
Standard Deviation		8.19	0.14

For the purpose of data analysis, non-responses to the knowledge items were categorized as incorrect answers. The percentage scores for each knowledge item are presented in **Table 4.3**. On question number 1 the majority of the students indicated they only knew a little or a fair amount about environmental issues and problems. Their self predicted environmental

knowledge was relatively accurate considering that the average percent correct score was 73.6% for the 11 environmental knowledge items.

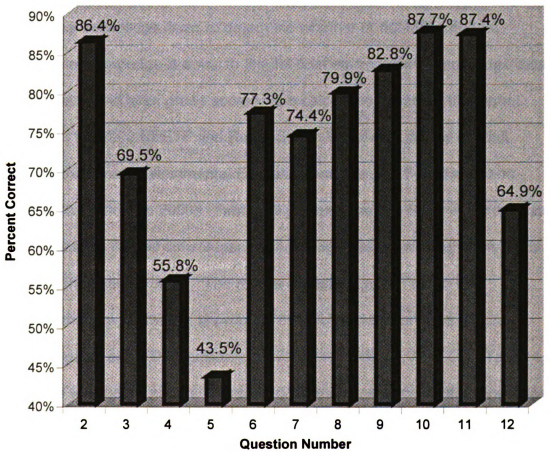
Table 4.3
Environmental Knowledge Questions – MSU Student Percent Correct Responses

Question	Knowledge Item	N	%
1	How much you think you know about environmental issues and problems.		
	A lot	448	7.5%
	A fair amount	2385	39.7%
	Only a little	2489	41.5%
	Practically nothing	494	8.2%
	Don't Know	199	3.1%
	Mean		20.0%
	SD		0.19
Question	**Knowledge Item**	**Correct**	**Incorrect**
2	Definition of Biodiversity.	86.4%	13.6%
3	Motor Vehicles are the largest contributor of carbon monoxide.	69.5%	30.5%
4	Most electricity in the U.S. is generated from burning oil, coal, and wood.	55.8%	44.2%
5	Surface water runoff is the most common cause of water pollution.	43.5%	56.5%
6	Trees are a renewable resource.	77.3%	22.7%
7	Ozone protects us from cancer-causing sunlight.	74.4%	25.6%
8	Most of the garbage in the U.S. ends up in landfills.	79.9%	20.1%
9	The EPA is the primary federal agency working to protect the environment.	82.8%	17.2%
10	Batteries are a household hazardous waste.	87.7%	12.3%
11	Human destruction of habitat is the most common reason for animal extinction.	87.4%	12.6%
12	The U.S. stores and monitors its nuclear waste.	64.9%	35.1%
	Mean	73.6%	26.4%
	Std. Deviation	0.1417	0.1417

The 11 environmental knowledge items and their respective scores are illustrated in **Figure 4.1**. As **Table 4.1** and **Figure 4.1** illustrate, the question

most often answered correctly was question 10 (87.7%). Question 10 dealt with respondent knowledge that batteries are a household hazardous waste. Interestingly, this question was also the question with the highest non-response rate. Students also scored well on questions related to household hazardous waste (question 9) and biodiversity (question 2). The questions with the lowest correct scores were questions 4 and 5. Question 4 addressed electricity generation while Question 5 asked about the most common cause of water pollution. Question 4 is worthy of note because it was the question least likely to be left blank.

Figure 4.1
MSU Student Environmental Knowledge Percent Correct Scores Per Question



Hypothesis Testing

Hypothesis One: $H_0: K_{MSU} = K_{NAT}$

$H_1: K_{MSU} > K_{NAT}$

The non-parametric Chi-Square test was used to test the first hypothesis which sought to determine whether there exists a difference in environmental knowledge levels of MSU students and the American public. The environmental knowledge of the American public is based on data acquired by the National Environmental Education and Training Foundation [NEETF] and Roper Starch Worldwide annual survey of adult Americans in the year 2000. The non-parametric Chi-Square test was used to test overall environmental knowledge and individual knowledge items to determine whether or not MSU student environmental knowledge is equal to the national environmental knowledge data. Pass / fail rates and letter grade scores were calculated based on the format presented in the 2000 NEETF and Roper Starch Worldwide survey of adult Americans (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000). **Table 4.4** presents the Chi-Square test data and results comparing overall environmental knowledge pass / fail rates of the MSU students to the national data. The results indicate rejection of the null hypothesis that environmental knowledge of MSU students and the national sample are equal at a 0.01 significance level ($x^2 = 3106.918$, $P < 0.00$). **Table 4.5** further tests whether or not there exists a difference in environmental knowledge levels by comparing letter grades for the two samples. Again, the Chi-Square

test statistic indicates inequality between the two samples at a 0.01 significance level ($x^2 = 4490.787$, $P < 0.00$).

Table 4.4
MSU Survey and National Survey Pass / Fail Percentages & Chi-Square Statistics

Pass / Fail Percentage*	MSU Survey	National Survey	Difference
Pass	66	32	31
Fail	34	68	-34
*Chi-Square Value = 3106.918; d.f. = 4; and P-value = 0.000			

Table 4.5
MSU Survey and National Survey Grade Distribution and Chi-Square Statistics

Report Card*	MSU Survey	National Survey	Difference
A	34.6	11	23.6
B	17.2	10	7.2
C	13.8	11	2.8
D	10.9	13	-2.1
F	23.6	55	-31.4
*Chi-Square Value = 4490.787; d.f. = 4; and P-value = 0.000			

A review of the percent passing data indicates that the students at MSU were 31% more likely to receive a passing score on the combined knowledge items (see **Table 4.4**). Furthermore, the students were 23.3% more likely to achieve a grade "A" whereas; the national public is almost 32% more likely to receive a grade of "F" when compared to the student sample (see **Table 4.5**). Unfortunately however, while more knowledgeable than the national sample, university students did not score high enough overall to receive a passing grade.

The Chi-Square test statistics indicate a significant difference between the

knowledge levels of the two samples. A review of the frequencies related to overall environmental knowledge scores revealed that MSU students exceed the national average of adult Americans in regard to environmental knowledge. The Chi-Square findings reject the null hypothesis that MSU students have the same environmental knowledge level as the general public and support the alternative hypothesis that university students at MSU have more environment knowledge than the general public.

In addition to the analysis of the overall environmental knowledge scores, the non-parametric Chi-Square test was used to test for equality of the two samples on each knowledge item. The results of the individual knowledge question Chi-Square tests are presented in **Table 4.6**. In comparison to the national survey of adult Americans, students were approximately 23% less likely to rate their environmental knowledge as being "a lot" or "a fair amount" and 20% more likely to rate their environmental knowledge as being "only a little" or "practically nothing". Although MSU students considered themselves less knowledgeable about the environment when compared to the national average, they were in fact 15.3% more likely to answer correctly than the respondents to the national survey.

Table 4.6
Percent Correct Responses and Chi-Square Results for the Relationship Between Environmental Knowledge of MSU Students and Adult Americans

Question 1- Perceived Knowledge	MSU	National	Difference
A lot	7.5	11	-3.5
A fair amount	39.7	59	-19.3
Only a little	41.5	24	17.5
Practically nothing	11.3	6	5.3
Chi-Square Value =6781.91; d.f.=4, & P-value=0.000			

Questions 2-12	MSU	National	Difference	Chi-Square	d.f.	P-value
Definition of Biodiversity	86.4	41	45.4	5043.97	4	0.000
Motor Vehicles are the largest contributor of carbon monoxide.	69.5	65	4.5	1499.60	4	0.000
Most electricity in the U.S. is generated from burning oil, coal and wood.	55.8	33	22.8	2395.11	4	0.000
Surface water runoff is the most common cause of water pollution.	43.5	28	15.5	5001.71	4	0.000
Trees are a renewable resources.	77.3	65	12.3	1096.17	4	0.000
That ozone protects us from cancer-causing sunlight.	74.4	54	20.4	1086.46	4	0.000
Most of the garbage in the U.S. ends up in landfills.	79.9	85	-5.1	4440.07	4	0.000
The EPA is the primary federal agency that works to protect the environment.	82.8	72	10.8	561.465	4	0.000
Batteries are a household hazardous waste.	87.7	67	20.7	1576.97	4	0.000
Human destruction of habitat is the most common reason for animal extinction.	87.4	74	13.4	901.536	4	0.000
U.S. stores and monitors its nuclear waste.	64.9	57	7.9	707.889	4	0.000
Mean	73.6	58.27	15.33			
Max	87.7	85.00	45.4			
Minimum	43.5	28.00	-5.1			
Std. Deviation	14.17	17.86	12.8			
Variance	200.7	319.02	163.79			

On all questions except one, MSU students appeared to be more knowledgeable than the national average. The question on which students knew less than the national average was question number 4. Question 4 tests respondents on their knowledge of garbage disposal in the United States. The respondents were 5% more likely to answer this question incorrect when compared to the national sample of adult Americans. The question with the biggest disparity between MSU responses and national average responses involved identifying the definition of biodiversity (question 2). On average, the students answered this question correctly 45.4% more often than did the national average.

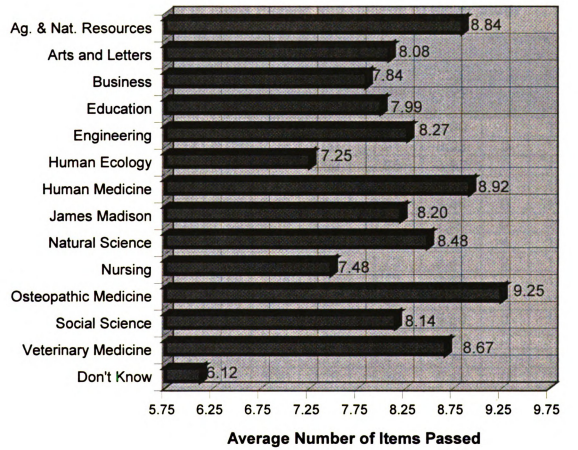
In the aggregate, MSU student respondents failed a total of 4 out of the 11 questions. The respondents in the national survey of adult Americans failed 8 of the 11 questions. Both populations failed to correctly identify the major contributor of carbon monoxide, the primary source of electricity generation in the United States, the most common cause of water pollution, and the method of nuclear waste disposal in the United States. In contrast, survey respondents in each population received a passing grade on the questions related to landfills, the EPA, and the leading cause of animal extinction.

Hypothesis Two: H_0 : $K_{C1} = K_{C2} = K_{C3} = K_{C4} = K_{C5} = K_{C6} = K_{C7} = K_{C8} = K_{C9} = K_{C10} = K_{C11} = K_{C12} = K_{C13} = K_{C14} = K_{C15}$

H_1 : **Not all** K_{Ci} **(i = 1, ..., 15) are equal**

The analysis of variance (ANOVA) test was used to determine whether student knowledge levels varied between the different colleges. The oneway ANOVA test takes the 11 environmental knowledge questions and compares the average number of correct answers by MSU students within varying colleges of major study. **Figure 4.2** displays the variation between means. The descriptive statistics for the ANOVA test are presented in **Table 4.7**.

Figure 4.2
Mean Number of Items Passed by College Major



Based on the mean scores for the number of items answered correctly,

the data indicates that students studying in the Colleges of Osteopathic (mean = 9.25) and Human Medicine (mean = 8.92) were the most knowledgeable about environmental issues and problems. Of the students able to identify their college of major study, the students in the Colleges of Human Ecology (mean = 7.25) and the College of Nursing (mean = 7.48) received the lowest scores. Students with no preference or no knowledge of their college of major study answered the least number of questions correctly with a mean score of 6.12.

Table 4.7
Descriptive Statistics for the ANOVA Test for the Relationship Between the Average Number of Items Passed and College of Major Study

					95% Confidence Interval for Mean			
College Major	N	Mean	SD	Std. Error	Lower Bound	Upper Bound	Min.	Max.
Ag. & Nat. Resources	624	8.84	2.03	0.08	8.68	9.00	1	11
Arts and Letters	714	8.08	2.28	0.09	7.91	8.25	0	11
Business	663	7.84	2.37	0.09	7.66	8.02	0	11
Education	578	7.99	2.43	0.10	7.79	8.19	0	11
Engineering	577	8.27	2.33	0.10	8.08	8.46	0	11
Human Ecology	226	7.25	2.35	0.16	6.94	7.56	0	11
Human Medicine	115	8.92	1.64	0.15	8.62	9.23	4	11
James Madison	110	8.20	2.49	0.24	7.73	8.67	2	11
Natural Science	813	8.48	2.24	0.08	8.33	8.63	0	11
Nursing	80	7.48	2.06	0.23	7.02	7.93	0	11
Osteopathic Medicine	118	9.25	1.90	0.17	8.90	9.59	0	11
Social Science	744	8.14	2.21	0.08	7.98	8.30	0	11
Veterinary Medicine	233	8.67	1.98	0.13	8.41	8.93	1	11
Don't Know	406	6.12	3.30	0.16	5.80	6.44	0	11

The descriptive statistics shown in **Table 4.7** and **Figure 4.2** indicate that there are differences in the environmental knowledge levels of students among differing colleges suggesting a rejection of the null hypothesis. To test the null

hypothesis that there is no difference in knowledge between the colleges the analysis of variance (ANOVA) test is used. The results of the ANOVA test are presented in **Table 4.8**.

Table 4.8
ANOVA Test Results – Mean Number of Correct Items by College of Study

ANOVA Test	Sum of Squares	df	Mean Square	F-Value	P-Value
Between Groups	2625.328	14	187.523	34.500	0.000
Within Groups	32553.061	5989	5.435		
Total	35178.39	6003			

The ANOVA test results support rejection of the null hypothesis that MSU student environmental knowledge is equal among varying colleges of major study ($F=34.50$, $P < 0.00$). Consequently, the alternative hypothesis that student environmental knowledge differs depending on the students' college of study is supported.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The first objective of this study was to assess the level of environmental knowledge of students at Michigan State University as compared to the national average. The second objective was to investigate the relationship between MSU students' environmental knowledge and the college in which they are majoring. To achieve these objectives, the following hypotheses were tested.

Hypothesis One: H_0 : $K_{MSU} = K_{NAT}$

H_1 : $K_{MSU} > K_{NAT}$

(Where K_{MSU} represents the percent passing scores for Michigan State University students, and K_{NAT} represents percent passing scores for the National sample.)

Hypothesis Two: H_0 : $K_{C1} = K_{C2} = K_{C3} = K_{C4} = K_{C5} = K_{C6} = K_{C7} = K_{C8} = K_{C9} = K_{C10} = K_{C11} = K_{C12} = K_{C13} = K_{C14} = K_{C15}$

H_1 : **Not all K_{Ci} (i = 1, ..., 15) are equal**

(Where K_{C1} through K_{C15} represent the mean knowledge scores for the 15 colleges within Michigan State University.)

The population selected for this study was selected from students at Michigan State University. The sample was stratified across seven academic levels at MSU. Those levels were freshman, sophomore, junior, senior, masters,

professional, and doctoral. The total sample size was 19,890 students and it consisted of five independent, randomly selected mailing lists of MSU students. Students participated in the study by completing either a hard copy or web-based survey instrument which consisted of 56 questions. The twelve questions related to environmental knowledge were the focus of this study. A total of 6004 students participated in the survey constituting a 30% response rate.

To test the hypotheses, responses to the survey instrument were analyzed by one or more of the following techniques: 1.) frequencies, 2.) descriptive statistics (mean and standard deviation), 3.) Chi-Square, and 4.) analysis of variance (ANOVA). Results were presented in either table or graph format in an effort to simplify reader comprehension and understanding of the data.

The null hypothesis that the two groups do not differ was rejected at a 0.01 significance level. Students at MSU do appear to have more knowledge of environmental issues and problems than the American national average. The data frequencies indicated that the students possessed more knowledge of the environment when compared to the national sample at a 2:1 ratio. In addition, the MSU students were approximately 24% more likely to score in the highest percent range (91-100%) and achieve an "A" grade. Given the results of the Chi-Square and frequency analyses, the null hypothesis was rejected and the alternative hypothesis stating that Michigan State University students will have more knowledge of environmental issues and problems than the national average was supported.

Although the students were more knowledgeable than the national sample of adults, their knowledge levels were disappointingly low. If the MSU student sample was issued a grade using the NEETF and Roper Starch grading scale, their overall grade would be a grade of "D". Using the NEETF and Roper Starch scale, a "D" grade is considered failing. Therefore, although the difference in percentage passing scores for the two samples is significant, the actual numbers indicate an inability to achieve a passing grade in environmental knowledge shared between both populations.

The data also indicated that students are more realistic about their knowledge of the environment when compared to the national sample of adults. If the following letter grades were assigned to the answer choices for the perceived knowledge question (question 1), the grades could be figured as follows: an indication of knowing a lot about the environmental is compatible with the letter grade of "A", an indication of knowing a fair amount about the environment is compatible with a letter grade of "B", an indication of knowing a little about the environment is compatible with a letter grade of "C", and an indication of knowing practically nothing is compatible with a failing grade of either "D" or "F". Given these comparisons, consider the following results.

The national survey showed that 70% of adult Americans consider themselves as knowing either a lot or a fair amount about environmental issues and problems meaning that, based on the aforementioned grading scheme, 70% would achieve a grade of "A" or "B". In reality, only 21% of respondents to the national survey scored grades of either "A" or "B". At Michigan State University,

the majority of the students (53%) at MSU indicated that they knew only a little or practically nothing about environmental issues and problems indicating, based on the grading scheme discussed above, 53% would achieve a grade of "C" or "F". In reality, 58.4% of the students scored s grade of "C" or "F". The differences in the two samples clearly indicate that the students' have a much better perception of their knowledge when compared to the national sample.

The only knowledge item on which the students failed to exceed the knowledge levels of the national sample was the question related to the fact that landfills are the primary method of disposal for the majority of garbage in the United States (question 4). Considering that students in their twenties were the most highly represented age group, the differences in knowledge for this question may be explained by respondents' inexperience. Given the dominant age group, the majority of the student respondents have most likely never owned a home or had to pay for refuse service. When living on campus, at their parents' home, or in an apartment students most likely dump their trash in large a dumpster, or put it out for someone else to dispose of. This may contribute to the difference in knowledge between the student and national populations and explain why students were less likely to know the correct answer.

The students and adults alike scored lowest on question 5 which required the knowledge that surface water runoff is the most common cause of water pollution. In addition to the cause of water pollution (question 5), both populations were unable to correctly identify motor vehicles as the major contributor of carbon monoxide, the burning of oil, coal, and wood as the largest

source of electricity generation in the United States, and storing and monitoring as the primary method of disposal for nuclear waste in the United States. In contrast, both samples (students and adults) scored at or above passing on the questions related to garbage being most commonly disposed of in landfills, that the Environmental Protection Agency [EPA] is the name of the federal agency that works to protect the environment and that human destruction of habitat is the leading cause of animal extinction.

The second hypothesis explored whether there would be a significant difference in students' level of environmental knowledge depending on their college of major study. The null hypothesis that MSU student knowledge would be equal among the varying colleges of major study was rejected at a 0.01 significance level. The statistical analysis suggests acceptance of the alternative hypothesis that there does exist a difference between the students' environmental knowledge and their college of major study ($F=34.50$, $P<0.00$).

Based on the average number of items passed (mean) the top five highest scoring colleges were the Colleges of Osteopathic Medicine (mean=9.25, sd=1.90), Human Medicine (mean=8.92, sd=1.64), Agriculture and Natural Resources (mean=8.84, sd=2.03), Veterinary Medicine (mean=8.67, sd=1.98) and Natural Science (mean=8.48, sd=2.24). The students who indicated "no preference / don't know" for their college of major scored the lowest (mean=6.12, sd=3.30) followed by the Colleges of Human Ecology (mean=7.25, sd=2.35), Nursing (mean=7.48, sd=2.06), Business (mean=7.84, sd=2.37), and Education (mean=7.99, sd=2.43).

It was of no surprise to the researcher that the environmentally focused Colleges of Agriculture and Natural Resources and Natural Science scored within the top five. It is interesting however that the Colleges of Medicine (i.e. Osteopathic, Human, and Veterinary) where among the highest scoring and had the least amount of deviation. In contrast, the Colleges of Human Ecology and Nursing were among the least environmentally knowledgeable. Although not intended to be a focus of the reported research, a review of demographic frequencies provides some insight into the reported differences between the colleges.

A review of academic level differences of students in the assorted colleges suggests a correlation between academic level and environmental knowledge. Students seeking either a professional or doctoral degree appear to dominate the Colleges of Osteopathic, Human and Veterinary Medicine. These students' are upper level graduate students whom, at a minimum have already finished their baccalaureate degrees. Similarly, the respondents from the Colleges of Natural Science and Agriculture and Natural Resources were dominated by doctoral students who would have completed both a baccalaureate and a masters or professional degree. The College of Human Ecology, which had the lowest score of defined colleges, was dominated by students in their junior or senior year of the baccalaureate study. The no preference / don't know category which had the lowest score overall was dominated by undergraduate freshman and sophomores.

In a national study of adult Americans, the respondents with a high school level education were found to possess less environmental knowledge than college educated respondents (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000). The results of the reported research appear to support the findings of the national survey data since freshman were the least knowledgeable and highly educated students possessed the most environmental knowledge. In addition, the national survey indicated that college students received an environmental score equivalent to a C- / D+ grade (National Environmental Education and Training Foundation and Roper Starch Worldwide 2000). The reported research revealed that MSU students have an environmental knowledge score equivalent to a letter grade of "D". These results also support the findings presented in the national survey. Overall, the current study indicates support for the notion that environmental knowledge increases with educational attainment (Maloney and Ward 1973; Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Arcury 1990; Miller 1990; Arcury and Christianson 1993; Hsu and Roth 1996; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Dunaway 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000).

The correlation between environmental knowledge and educational attainment is also evident when reviewing demographic characteristics in relation to pass / fail rates of the MSU student sample. **Appendix G** shows the percent passing rates for each academic level. Within the academic levels, 70% of the

professional students achieved a passing score followed by doctoral students (46%), seniors (39%), masters (36%), juniors (34%), sophomores (24%) and freshman (-2%). Clearly, this data supports the notion that environmental knowledge increases with educational attainment because students achieve higher levels of education as they progress through the university.

Previous research has also indicated a relationship between environmental knowledge and gender, with men possessing more knowledge than women (Arcury et al. 1986; Arcury and Johnson 1987; Arcury et al. 1987; Blum 1987; Fortner and Mayer 1988; Barrow and Morrisey 1988-1989; Arcury 1990; Miller 1990; Arcury and Christianson 1993; Benton 1994; National Environmental Education and Training Foundation and Roper Starch Worldwide 1998; Gambro and Switzky 1999; National Environmental Education and Training Foundation and Roper Starch Worldwide 1999, 2000; Tikka et al. 2000). An initial review of the relationship between gender and environmental knowledge of the MSU student sample seemed to indicate that the women scored better than the men (see **Appendix H**). An assessment of percent passing scores showed women achieving 35% passing and men achieving 31.1% passing. This information appears to contradict previous research.

Upon further analysis, a review of percent passing may not adequately represent the results. While the women appeared to score higher, it is important to recognize that there were 20% more women respondents. Also, 24.4% of women respondents received a failing grade as compared to 9.5% of the male respondents. Within the male gender category, men received a passing score

53% more often then a failing score. Within the female gender category, women received a passing score 18% more often then a failing score. Given these differences, it would seem as though males were more likely to pass and therefore more environmentally knowledgeable when compared to the women thus supporting the findings of previous research.

An analysis of environmental knowledge and its relationship to age for the MSU student sample is attached in **Appendix I**. Previous research has supported the notion that environmental knowledge increases with age (Arcury et al. 1987; Arcury 1990; Arcury and Christianson 1993; National Environmental Education and Training Foundation and Roper Starch Worldwide 1997, 1998, 1999, 2000; Tikka et al. 2000). A review of percent passing scores for the MSU student sample, sorted by age group appears to support this notion. The highest scoring age group was the over 60 group within which 100% of the students achieved a passing grade. The 50-59 year old students achieved a 77% passing rate followed by the 40-49 year old students with 58% passing, the 30-39 year old students passed 39% and the 20-29 age group had a 34% passing rate. Students under age 20 (-9%) and the students who did not indicate their age (-37%) were both more likely to achieve a failing score rather than passing.

Research Limitations

There may be a number of potential weaknesses in the reported research. These possible limitations are discussed in detail below.

1.) The knowledge items were a component of a larger survey. Respondents believed that they were participating in a survey of the Red Cedar River on the campus of Michigan State University. It is unknown how the context in which the survey was introduced and presented to the sample affected the response / non-response rates.

2.) The study did not compare the respondent population to the MSU population. Therefore, it is unknown whether or not the sample is representative of the overall student population of Michigan State University.

3.) The reported research presents no information on the non-respondent population and how or if they differ socially or demographically from the respondent population.

4.) The environmental knowledge and environmental education background of student respondents prior to entering the university is unknown.

5.) Michigan State University has a diverse population that includes students from all over the world. A number of the knowledge items were specific to environmental problems and issues in the United States. The reported research does not investigate the nationality of respondents and how it affected their responses.

6.) The knowledge items used to determine the level of environmental knowledge were created and pretested 5 years prior to the reported research. Having found no evidence of further testing into the validity

and reliability of these questions, they may no longer accurately reflect what constitutes a basic knowledge of the environment. The knowledge questions may no longer be relevant measures of environmental knowledge.

Recommendations

The findings of this research indicate that MSU students are more knowledgeable about environmental issues and problems when compared to a national sample of adult Americans. However, it is important to recognize that the overall environmental knowledge level of the MSU student is not high enough to be considered as a passing grade when calculated using the NEETF and Roper Starch Worldwide survey figures. The overall score for student respondents to the MSU survey was 66% which again, using the NEETF and Roper Starch Worldwide scale computes to a letter grade of "D" which was considered to be a failing grade.

The majority of the student respondents to the Michigan State University survey were born between 1973 and 1982 and have thus grown up a product of the environmental education movement. The success of environmental education efforts of the past three decades should be apparent in the university survey results given the primary age group, however the results of this study do not present a clear success in primary environmental education in Michigan. The reported research suggests that K-12 environmental education efforts may have failed to reach these students and educate them to a literate level because

the freshman respondents were the least likely to achieve a passing score. Given these results the implications of this study may apply to more than just institutions of higher learning.

Kindergarten through twelfth grade educators may not be producing environmentally literate high school graduates and while the university does seem to improve environmental knowledge; overall environmental literacy is far from being widespread. Perhaps these deficiencies in environmental education may be addressed by organizations and supporters calling for and strengthening environmental education efforts within all facets of education be it pre-school, high school or adult levels.

One interesting component of the current study was the lack of environmental knowledge among students in the College of Education. The College of Education was ranked tenth among the fourteen college choices ranking above the Colleges of Business, Nursing, Human Ecology and the no preference / don't know choice. It seems important for tomorrow's teachers to possess knowledge of the environment so that they can help properly educate their students about environmental issues and problems. The apparent lack of environmental literacy of students studying to become K-12 teachers is troubling. More research is needed to determine the role that teachers and their education play in the environmental education of the children they teach.

The results of the reported research also has implications for institutions of higher learning in the United States. The research suggests an increase in university students' environmental knowledge commensurate with increases in

academic level. This indicates that as MSU students progress through their college career, they become more knowledgeable about environmental issues and problems. However, it does seem that this increase in environmental knowledge is especially apparent in students studying in an environmentally related field or those pursuing a graduate or doctoral degree. The lack of environmental knowledge and the disparity among students in different colleges as indicated in this research suggest that environmental education has not been institutionalized across the MSU curriculum.

The findings of this research suggest that environmental education efforts may need to be strengthened at the university level. If MSU is representative of colleges and universities, institutions of higher learning must work harder to improve environmental education so that environmental knowledge is disseminated to all students regardless of their college of major study. As a land grant university MSU may be better than many universities. If this is so, there may be much work needed to insure that a well-rounded college education includes knowledge of environmental issues and problems. It is important that institutions of higher learning recognize the importance of producing graduates who have an understanding of the natural environment and how human actions affect it.

Future Research

Throughout the course of this research many ideas for additional research were formulated. Some possible avenues for further research include:

1.) Investigate and analyze the environmental knowledge of university and college students at varying types of institutions of higher learning (e.g. private, public, community, liberal arts, research, Land-Grant).

2.) Investigate and analyze the environmental knowledge of university and college students in varying regions of the United States (e.g. southeast, mid-west, northwest, etc.).

3.) Investigate the cause(s) of environmental knowledge and education differences within different colleges within the university.

4.) Investigate and analyze the environmental knowledge level of university level decision and/or policy makers.

5.) Investigate the attitudes of university level decision and/or policy makers towards the institutionalization of environmental education within institutions of higher learning.

6.) Further investigate the demographic and social characteristics related to the environmental knowledge levels of university students.

7.) Investigate how demographic and social characteristics relate to how university and college students choose their major field of study within the university.

8.) Investigate and analyze the effectiveness of different environmental education approaches at the university and college level.

9.) Analyze and test the environmental knowledge items to ensure relevancy and subject area coverage adequacy.

10.) Identify and create a more comprehensive set of environmental education assessment tools (better survey questions).

11.) Analyze the most common wrong answer to the environmental knowledge items.

12.) Compare respondent population demographics to the demographic characteristics of MSU's overall population to analyze how the university is represented in the sample.

13.) Investigate and analyze the relationship between environmental knowledge, environmental attitudes, and environmental activities of university students.

Concluding Remarks

The objectives of this study were to assess how knowledgeable students at Michigan State University are about environmental issues and to examine how their knowledge level varies depending on the college within which they are majoring. The reported research indicates that students at Michigan State University are more knowledgeable regarding environmental issues and problems than the American public. However, while more knowledgeable, student knowledge score equates to a disappointingly low letter grade of "D". Using the NEETF and Roper Starch Worldwide grading scale, this grade is considered failing.

Within the University, environmental knowledge varies significantly depending on students' college of major study. The knowledge levels within

colleges appeared to be effected by the academic level of student respondents within that college. The higher educated graduate students appeared to positively affect the environmental knowledge scores of the individual colleges.

Given the results, both null hypotheses were rejected and the goals set by the research objectives were obtained. The research presented in the current study adds to the existing knowledge base of environmental knowledge literature and provides many avenues of exploration for future research studies.

APPENDICES

APPENDIX A

University Committee on Research Involving Human Subjects [UCRIHS]
MSU-WATER Student Survey Approval

MICHIGAN STATE
UNIVERSITY

March 19, 2001

TO: Michael KAPLOWITZ
311a Natural Resources Bldg

RE: **IRB# 01-121** CATEGORY: EXPEDITED 2-F, 2-G
APPROVAL DATE: March 19, 2001

TITLE: MSU-WATER SOCIAL ASSESSMENT: STAKEHOLDER ATTITUDES, BELIEFS, AND USES OF THE UNIVERSITY'S RED CEDAR RIVER WATERSHED

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete and I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the **UCRIHS approved this project.**

RENEWALS: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Projects continuing beyond one year must be renewed with the green renewal form. A maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for a complete review.
REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB# and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.
PROBLEMS/CHANGES: Should either of the following arise during the course of the work, notify UCRIHS promptly: 1) problems (unexpected side effects, complaints, etc.) involving human subjects or 2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of further assistance, please contact us at (517) 355-2180 or via email: UCRIHS@msu.edu. Please note that all UCRIHS forms are located on the web: http://www.msu.edu/user/ucrihs

Sincerely,

Ashir Kumar, M.D.
Interim Chair, UCRIHS

AK: br
cc: Scott G. WITTER
319 Natural Resources Building
MSU

OFFICE OF
RESEARCH AND GRADUATE STUDIES
University Committee on Research Involving Human Subjects
Michigan State University
246 Administration Building
East Lansing, Michigan
48824-1046
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FAX: 517/353-2976
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E-Mail: ucrihs@msu.edu

APPENDIX B

MSU-WATER Student Survey Instrument

MICHIGAN STATE
UNIVERSITY

WATERSHED ACTION THROUGH EDUCATION & RESEARCH

[MSU-WATER]

2001 Student Survey

MICHIGAN STATE
UNIVERSITY

You have been selected to participate in a Michigan State University-sponsored research project entitled "MSU-WATER." This research is being conducted under the supervision of Dr. Michael D. Kaplowitz and Dr. Scott G. Witter. The purpose of this study is to explore what you know, understand and hope for the Red Cedar River and watershed. The results of the study will be used in campus planning. The survey will take approximately 10 to 15 minutes to complete. While your input is extremely valuable, your participation is **voluntary**.

We appreciate you taking the time to complete the survey. To thank you for responding by November 15, 2001, you are eligible to enter a drawing to win one (1) of eight (8) $100 gift certificates to the MSU Bookstore. To participate in this drawing, please complete the raffle entry form at the end of the questionnaire and return it with the completed survey.

Data gathered from this survey will be treated with strict confidentiality. Researchers will compile information from the completed questionnaire separate from the list of raffle participants. The names, phone numbers, and Pilot IDs of participants will **not** be linked to responses or used in any reports resulting from the survey. **Your privacy will be protected to the maximum extent allowable by law.**

If you have any particular questions about this study, please call the primary investigator, Dr. Michael D. Kaplowitz at (517) 355-0101. If you have questions regarding your role and rights as a research participant, please contact Dr. David E. Wright, Chair of the University Committee on Research Involving Human subjects at (517) 355-2180.

If you understand that responding to this survey is voluntary, and you consent to participate, please continue and answer the following questions.

Return your completed questionnaire in the envelope provided addressed to:
MSU-WATER Survey, 323 Natural Resource Bldg, Michigan State University,
E. Lansing, MI 48824

Thank you for your help and participation!

This Project was approved by UCRIHS on March 19, 2001. Approval expires on March 19, 2002.

0-[illegible]

A. FOR THE FOLLOWING 3 QUESTIONS, PLEASE SHARE YOUR PERCEPTION OF THE RED CEDAR RIVER.

A1. Which one of the following comes closest to your perception of the Red Cedar River on Campus?
(Mark ● one)

- ○ 1 The river is the most important feature of the campus.
- ○ 2 The river is an important feature of the campus.
- ○ 3 The river is a somewhat important feature of the campus.
- ○ 4 The river is not an important feature of the campus.

A2. Which one of the following comes closest to your perception of the condition of the Red Cedar River on Campus?
(Mark ● one)

- ○ 1 The river is extremely polluted (not safe for any use).
- ○ 2 The river is polluted, but safe for recreational purposes.
- ○ 3 The river is not polluted.
- ○ 4 Unsure

A3. From which of the following sources have you received information about the Red Cedar River?
(Mark ● all that apply)

- ○ 1 Appearance (i.e., just looking at it)
- ○ 2 State News (Campus newspaper)
- ○ 3 Personal experiences (i.e., doing things in connection with it)
- ○ 4 Lansing State Journal
- ○ 5 Television
- ○ 6 M.S.U. Extension
- ○ 7 Coursework (Classes)
- ○ 8 Ingham County Health Department / Drain Commission Notices
- ○ 9 Other: (please list) _____

_____

B. FOR THE FOLLOWING 3 QUESTIONS, PLEASE INDICATE HOW FAMILIAR YOU ARE WITH THE RED CEDAR RIVER.
(Mark ● one response for each statement)

B1. The Red Cedar River and its network of streams and drains (i.e., "the watershed").

- ○ 1 Very Familiar
- ○ 2 Familiar
- ○ 3 Somewhat Familiar
- ○ 4 Not at all Familiar

B2. Walkways along and/or access points to the river on campus.

- ○ 1 Very Familiar
- ○ 2 Familiar
- ○ 3 Somewhat Familiar
- ○ 4 Not at all Familiar

B3. Local Red Cedar River clean-up activities.

- ○ 1 Very Familiar
- ○ 2 Familiar
- ○ 3 Somewhat Familiar
- ○ 4 Not at all Familiar

CONTINUE ➜

C. FOR THE NEXT 5 QUESTIONS, PLEASE INDICATE HOW OFTEN YOU DO THE FOLLOWING ACTIVITIES ALONG THE RED CEDAR RIVER ON CAMPUS.
(Mark ● one response for each statement)

C1. Walk, jog, or bike along the sidewalks of the Red Cedar River on campus.

- ○ 1 Daily
- ○ 2 Weekly
- ○ 3 Monthly
- ○ 4 Once in a While
- ○ 5 Never

C2. Visit the woodlands or natural areas along the Red Cedar River on campus.

- ○ 1 Daily
- ○ 2 Weekly
- ○ 3 Monthly
- ○ 4 Once in a While
- ○ 5 Never

C3. Canoe or kayak on the river on campus.

- ○ 1 Daily
- ○ 2 Weekly
- ○ 3 Monthly
- ○ 4 Once in a While
- ○ 5 Never

C4. Feed the ducks along the river on campus.

- ○ 1 Daily
- ○ 2 Weekly
- ○ 3 Monthly
- ○ 4 Once in a While
- ○ 5 Never

C5. Have a picnic, eat a snack or take a break along the river on campus.

- ○ 1 Daily
- ○ 2 Weekly
- ○ 3 Monthly
- ○ 4 Once in a While
- ○ 5 Never

D. FOR THE NEXT 8 QUESTIONS, PLEASE SHARE YOUR OPINION OF THE SIGNIFICANCE OF THE FOLLOWING POSSIBLE SOURCES OF POLLUTION FOR THE RED CEDAR RIVER.
(Mark ● one response for each item)

D1. Animals and Livestock.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

CONTINUE ➔

D2. Storm Drains.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

D3. Industrial Drain Pipes.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

D4. Lawns, Fields or Woodlots.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

D5. Construction Sites.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

D6. Farms or Farm Related Activities.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

D7. Land use changes.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

D8. Impervious surface runoff (e.g. parking lots, roads, etc.).

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

CONTINUE ➜

E. FOR THE FOLLOWING 5 QUESTIONS, PLEASE INDICATE YOUR OPINION OF THE SIGNIFICANCE OF MSU's CONTRIBUTION TO DOWNSTREAM POLLUTION FROM THE FOLLOWING POSSIBLE SOURCES .
(Mark ● one response for each item)

E1. Animals and Livestock.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

E2. Storm Drains.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

E3. Lawns, Fields or Woodlots.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

E4. Farms or Farm Related Activities.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

E5. Impervious surface runoff (e.g. parking lots, roads, etc.).

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

F. FOR THE NEXT 5 QUESTIONS, PLEASE INDICATE YOUR OPINION OF THE SIGNIFICANCE OF THE FOLLOWING POSSIBLE TYPES OF POLLUTION FOR THE RED CEDAR RIVER ON CAMPUS?
(Mark ● one response for each item)

F1. Fecal Coliform (E Coli).

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

CONTINUE ➔

F2. Pesticides, herbicides and fertilizers.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

F3. Sediment runoff.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

F4. Excessive Flow and Flooding.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

F5. Solvents, Cleaners and Detergents.

- ○ 1 Very Significant
- ○ 2 Significant
- ○ 3 Somewhat Significant
- ○ 4 Not at all Significant
- ○ 5 Unsure

G. FOR THE FOLLOWING 8 QUESTIONS, CONSIDER SOME SUGGESTED PRACTICES FOR IMPROVING WATER QUALITY. PLEASE SHARE WITH US YOUR OPINION OF HOW ACCEPTABLE THEY ARE FOR USE ON CAMPUS.

(Mark ● one response for each statement.)

G1. Constructing wetlands on campus.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

G2. Changing the way pesticides, herbicides and fertilizers are used on campus.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

CONTINUE ➜

G3. Building vegetative buffer strips along the river.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

G4. Building water detention basins.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

G5. Decreasing areas that do not allow water to seep into the soil.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

G6. Changing manure management practices on campus.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

G7. Building a campus wastewater treatment facility.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

G8. Changing the way fallen trees and woody debris are managed in the river.

- ○ 1 Very Acceptable
- ○ 2 Acceptable
- ○ 3 Somewhat Acceptable
- ○ 4 Not at all Acceptable
- ○ 5 Unsure

CONTINUE ➜

H. IN ORDER FOR US TO BETTER UNDERSTAND YOUR LEVEL OF ENVIRONMENTAL KNOWLEDGE, PLEASE ANSWER THE NEXT 12 QUESTIONS. IF YOU DON'T KNOW THE ANSWER, PLEASE MARK "DON'T KNOW."

(Mark ● one response for each statement.)

H1. In general, how much do you feel you know about environmental issues and problems?

- ○ 1 A lot
- ○ 2 A fair amount
- ○ 3 Only a little
- ○ 4 Practically nothing
- ○ 5 Don't Know

H2. There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea?

- ○ 1 Multiplicity
- ○ 2 Biodiversity
- ○ 3 Socio-economics
- ○ 4 Evolution
- ○ 5 Don't Know

H3. Carbon monoxide is a major contributor to air pollution in the U.S. Which of the following is the biggest source of carbon monoxide?

- ○ 1 Factories and businesses
- ○ 2 People breathing
- ○ 3 Motor vehicles
- ○ 4 Trees
- ○ 5 Don't Know

H4. How is most electricity in the U.S. generated?

- ○ 1 By burning oil, coal and wood
- ○ 2 With nuclear power
- ○ 3 Through solar energy
- ○ 4 By hydro electric power plants
- ○ 5 Don't Know

H5. What is the most common cause of pollution of streams, rivers and oceans?

- ○ 1 Dumping of garbage by cities
- ○ 2 Surface water running off yards, city streets, paved lots and farm fields
- ○ 3 Trash washed into the ocean from beaches
- ○ 4 Waste dumped by factories
- ○ 5 Don't Know

H6. Which of the following is a renewable resource?

- ○ 1 Oil
- ○ 2 Iron Ore
- ○ 3 Trees
- ○ 4 Coal
- ○ 5 Don't Know

CONTINUE →

H7. Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from?

- ○ 1 Acid rain
- ○ 2 Global warming
- ○ 3 Sudden changes in temperature
- ○ 4 Harmful, cancer-causing sunlight
- ○ 5 Don't Know

H8. Where does most of the garbage in the U.S. end up?

- ○ 1 Oceans
- ○ 2 Incinerators
- ○ 3 Recycling centers
- ○ 4 Landfills
- ○ 5 Don't Know

H9. What is the name of the primary federal agency that works to protect the environment?

- ○ 1 Environmental Protection Agency (the EPA)
- ○ 2 Department of Health, Environment, and Safety (the DHES)
- ○ 3 National Environmental Agency (the NEA)
- ○ 4 Federal Pollution Control Agency (the FPCA)
- ○ 5 Don't Know

H10. Which of the following household wastes is considered a hazardous waste?

- ○ 1 Plastic Packaging
- ○ 2 Glass
- ○ 3 Batteries
- ○ 4 Spoiled Food
- ○ 5 Don't Know

H11. What is the most common reason that an animal species becomes extinct?

- ○ 1 Pesticides are killing them
- ○ 2 Their habitats are being destroyed by humans
- ○ 3 There is too much hunting
- ○ 4 There are climate changes that affect them
- ○ 5 Don't Know

H12. Scientists have not determined the best solution for disposing of nuclear waste. In the U.S. what do we do with it now?

- ○ 1 Use it as nuclear fuel
- ○ 2 Sell it to other countries
- ○ 3 Dump it in landfills
- ○ 4 Store and monitor the waste
- ○ 5 Don't Know

CONTINUE ➔

I. IN ORDER FOR US TO BETTER UNDERSTAND YOUR RESPONSES TO THE SURVEY QUESTIONS, WE WOULD LIKE YOU TO ANSWER SOME QUESTIONS ABOUT YOUR BACKGROUND. REMEMBER THAT YOUR RESPONSES ARE COMPLETELY CONFIDENTIAL.

I1. What is your current academic level? (Please ● mark one)

- ○ 1 Freshman
- ○ 2 Sophomore
- ○ 3 Junior
- ○ 4 Senior
- ○ 5 Masters
- ○ 6 Doctoral
- ○ 7 Professional

I2. In what college of MSU is your current major? If undecided please indicate your probable College association or that you do not know. (Please ● mark one)

- ○ College of Agriculture & Natural Resources
- ○ College of Arts and Letters
- ○ Eli Broad College of Business
- ○ College of Education
- ○ College of Engineering
- ○ College of Human Ecology
- ○ College of Human Medicine
- ○ James Madison College
- ○ College of Natural Science
- ○ College of Nursing
- ○ College of Osteopathic Medicine
- ○ College of Social Science
- ○ College of Veterinary Medicine
- ○ Detroit College of Law
- ○ No preference / Don't Know

I3. How far away do you currently live from the Red Cedar River? (Please ● mark one)

- ○ 1 Less than 5 blocks.
- ○ 2 Over 5 blocks.
- ○ 3 Unsure

I4. In what type of area did you grow-up (up to 18 years of age)? (Please ● mark one.)

- ○ 1 Rural, Farm
- ○ 2 Rural, non-Farm (2,500 people or fewer)
- ○ 3 Small Town (Between 2,501 and 25,000 people)
- ○ 4 Urban Area (Between 25,001 and 100,000 people)
- ○ 5 Metropolitan Area (More than 100,000 people)
- ○ 6 Unsure

I5. Thinking politically and socially, how would you describe your own general position? (Please ● mark one).

- ○ 1 Very conservative
- ○ 2 Moderately conservative
- ○ 3 Middle of the road
- ○ 4 Moderately liberal
- ○ 5 Very liberal
- ○ 6 Unsure

CONTINUE ➔

16. Are you...

- ○ 1 Male
- ○ 2 Female

17. In what year were you born? 19 

Thank you for your participation!

If you have any other comments you would like to share with us, please use the space below.

APPENDIX C

MSU-WATER Student Survey
Pretesting Script and Consent Form

Date:_____ Location:_____ Time:_____

Participant:_____ Moderator:_____

MSU-WATER STUDENT SURVEY
PRE-TESTING SCRIPT

1.) Introduction.
   a. Moderator Name.
   b. Working for Michael Kaplowitz.
   c. Department of Resource Development.

2.) Explain the project.
   a. Writing a survey to distribute in the fall.
   b. We would like to have some people take it and give us feedback.
   c. Payment for your time - $10.00.
   d. Explain Consent procedures – Get Signatures - - □.
   e. Fill out sheet for payment - - □.

3.) Administer the Survey.
   a. Time it takes to complete the survey: _____.
   b. Observe.
   c. Mark where something is not clear.

4.) Discuss the Survey.
   a. How did you feel (what were you thinking about) while taking it?

   b. How was the length?

   c. Were any of the questions confusing or make you feel uncomfortable?

Date:_____ Location:_____ Time:_____

Participant:_____ Moderator:_____

d. Was the language clear (questions and answer choices)?

e. In your own words, can you tell me what the goal of the survey is? What type of information are we trying to obtain?

f. Is there anything that you think is missing?

g. Is there anything that should be removed?

h. If you received this survey in the mail, would you do it?

i. If you received this by e-mail, would you do it?

j. Any other comments?

MICHIGAN STATE UNIVERSITY

DOCUMENTED INFORMED CONSENT

You have been invited to participate in a study entitled "MSU-WATER Social Assessment: Stakeholder Attitudes, Beliefs and Uses of the Red Cedar Watershed". This study is being conducted under the supervision of Dr. Michael Kaplowitz and Dr. Scott G. Witter. The primary investigators are faculty from the Department of Resource Development within the College of Agriculture and Natural Resources at Michigan State University. They may designate other persons to assist in conducting the study.

The main purpose of this study is to explore what MSU students and non-students know, understand and hope for the Red Cedar River and watershed. The results of the study will be used to gain information about perceptions and uses of the campus watershed and assist the investigators in conducting future research.

Today, you are being asked to e involved in a pre-test and short discussion of a draft survey instrument. The pre-test and discussion shall last no longer than 30 minutes. You may be assured that your responses will remain completely confidential, as references to your identify will be deleted from any reports or transcriptions. Your privacy will be protected to the maximum extent allowable by law. Participation is voluntary and you may choose not to participate at all, refuse to answer certain questions or withdraw from the pre-test at any time without repercussions.

If you have any questions about your rights as a research subject you may contact Dr. David Wright at Michigan State University's Office of Research and Graduate Studies at (517) 355-2180. Additionally, if you have questions about the study, please contact Michael Kaplowitz at (517) 355-0101.

By signing this form, you are acknowledging your voluntary participation in today's pre-testing. Thank you for your participation.

_____

(Print Name)

_____

(Sign Name)

_____

(Signature of principle investigator or authorized representative)

_____

(Date)

APPENDIX D

MSU-WATER Student Survey
Hardcopy Survey Consent Forms

MICHIGAN STATE
UNIVERSITY

You have been selected to participate in a Michigan State University-sponsored research project entitled "MSU-WATER." This research is being conducted under the supervision of Dr. Michael D. Kaplowitz and Dr. Scott G. Witter. The purpose of this study is to explore what you know, understand and hope for the Red Cedar River and watershed. The results of the study will be used in campus planning. The survey will take approximately 10 to 15 minutes to complete. While your input is extremely valuable, your participation is voluntary.

We appreciate you taking the time to complete the survey. To thank you for responding by November 15, 2001, you are eligible to enter a drawing to win one (1) of eight (8) $100 gift certificates to the MSU Bookstore. To participate in this drawing, please complete the raffle entry form at the end of the questionnaire and return it with the completed survey.

Data gathered from this survey will be treated with strict confidentiality. Researchers will compile information from the completed questionnaire separate from the list of raffle participants. The names, phone numbers, and Pilot IDs of participants will not be linked to responses or used in any reports resulting from the survey. **Your privacy will be protected to the maximum extent allowable by law.**

If you have any particular questions about this study, please call the primary investigator, Dr. Michael D. Kaplowitz at (517) 355-0101. If you have questions regarding your role and rights as a research participant, please contact Dr. David E. Wright, Chair of the University Committee on Research Involving Human subjects at (517) 355-2180.

If you understand that responding to this survey is voluntary, and you consent to participate, please continue and answer the following questions.

Return your completed questionnaire in the envelope provided addressed to:
MSU-WATER Survey, 323 Natural Resource Bldg, Michigan State University,
E. Lansing, MI 48824

Thank you for your help and participation!

This Project was approved by UCRIHS on March 19, 2001. Approval expires on March 19, 2002.

0-12428

MICHIGAN STATE
UNIVERSITY

Dear MSU Student:

As you might recall from an earlier mailing, you have been selected to participate in a study about the Red Cedar River. The study is part of an effort by Michigan State University to design a watershed plan for campus.

There is still time for your input. We have extended the deadline for the random drawing for MSU Student Bookstore Gift Certificates until Dec. 15th. We really would like to include your views and opinions because improving water quality involves trade-offs. Results of the questionnaire will help MSU researchers and administrators develop watershed management policies for the campus.

You have been selected as part of a scientific sample of MSU students. That is why we are asking you to take about 10 minutes to complete and return the enclosed questionnaire--so we can make sure that we get a scientific cross-section of MSU students. Your participation is vital in making sure that the information collected accurately represents MSU students.

Your participation is voluntary. We will keep your individual views entirely confidential. Rest assured, your privacy will be protected to the maximum extent allowable by law.

COLLEGE OF
AGRICULTURE AND NATURAL RESOURCES
Resource Development
Michigan State University
323 Natural Resources
East Lansing, Michigan
48824-1222
517/355-3421
FAX: 517/353-8994

If you have any questions or comments about this study feel free to call me at (517) 355-0101. If you have questions concerning your rights as a survey participant, please contact Dr. Ashir Kumar, Chair of the MSU Committee on Research Involving Human Subjects, at (517) 355-2180.

Thanks for participating in this study.

Sincerely,

Michael D. Kaplowitz
Assistant Professor, Department of Resource Development
T: 517-355-0101
E: kaplowit@msu.edu

APPENDIX E

MSU-WATER Student Survey
Implementation and Notification Materials

WEB-BASED SURVEY
E-MAIL NOTICE

-----Original Message-----
From: msu-water [mailto:msu-water@rd.msu.edu]
Sent: Tuesday, November 13, 2001 11:24 AM
To: Kolakows
Subject: MSU-Water Survey

Dear MSU student,

You have been selected to participate in a survey concerning MSU's Red Cedar River. Survey results will be used to help design a watershed management plan for the Red Cedar River on campus. Student participation is crucial for a successful project.

All we ask is that you log on to the survey website and complete the survey at:

http://www.msu-water.msu.edu

Because of mail processing delays, replies submitted by December 1st are eligible for the random prize drawing for one of eight $100 MSU Bookstore gift certificates.

Thank you for taking time out of your busy schedule to help in this important effort.

Thanks again,

Dr. Michael D. Kaplowitz & MSU-WATER Team

Remember, log on at http://www.msu-water.msu.edu

WEB-BASED SURVEY
POSTCARD NOTICE

MICHIGAN STATE
UNIVERSITY

Dear MSU student,

You have been selected to participate in a study concerning MSU's Red Cedar River. The survey results will help design a watershed management plan for the Red Cedar River on campus. Student participation is crucial for a successful project.

All that we ask is that you log on the survey website and complete the survey at www.msu-water.msu.edu. Thank you for taking time out of your busy schedule to help us in this important effort.

Thanks,
Dr. Michael D. Kaplowitz & MSU-WATER Team

Remember, log on at www.msu-water.msu.edu

HARD COPY SURVEY
PRE-NOTICE POSTCARD

MICHIGAN STATE
UNIVERSITY

Dear MSU student,

You have been selected to participate in a study concerning MSU's Red Cedar River. The study results will help design a watershed management plan for the Red Cedar River on campus. Student participation is crucial for a successful project.

All that we ask is that you complete a survey booklet that you will receive in the mail in just a few days. We are writing to you now since many people like to receive advance notice of the survey booklet. We hope that you will take time out of your busy schedule to help us in this important endeavor.

Thanks,

Dr. Michael D. Kaplowitz & MSU-WATER Team

HARDCOPY SURVEY
POST- SURVEY NOTIFICATION

MICHIGAN STATE
UNIVERSITY

Dear MSU student,

Last week, you should have received a survey about MSU's Red Cedar River. The results of this survey will help design a watershed management plan for the Red Cedar River on campus. Student participation is crucial for a successful project.

If you have not yet completed the survey, you still have time to do so. If you would like to receive another copy of the survey, please contact me at kaplowit@msu.edu or (517) 355-0101.

Thank you for your help and participation!

Dr. Michael D. Kaplowitz & MSU-WATER Team

APPENDIX F

NEETF AND ROPER STARCH WORLDWIDE ENVIRONMENTAL KNOWLEDGE QUESTIONS - CORRECT ANSWERS INDICATED BY BOLD FACE AND UNDERLINED TEXT

1. **In general, how much do you feel you know about environmental issues and problems?**
    - A lot
    - A fair amount
    - Only a little
    - Practically nothing
    - Don't Know

2. **There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea?**
    - Multiplicity
    - **Biodiversity**
    - Socio-economics
    - Evolution
    - Don't Know

3. **Carbon monoxide is a major contributor to air pollution in the U.S. Which of the following is the biggest source of carbon monoxide?**
    - Factories and businesses
    - People breathing
    - **Motor vehicles**
    - Trees
    - Don't Know

4. **How is most of the electricity in the U.S. generated?**
    - **By burning oil, coal and wood**
    - With nuclear power
    - Through solar energy
    - By hydro electric power plants
    - Don't Know

5. **What is the most common cause of pollution of streams, rivers and oceans?**
    - Dumping of garbage by cities
    - **Surface water running off yards, city streets, paved lots and farm fields**
    - Trash washed into the ocean from beaches
    - Waste dumped by factories
    - Don't Know

6. **Which of the following is a renewable resource?**

    - Oil
    - Iron ore
    - **Trees**
    - Coal
    - Don't Know

7. **Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from?**

    - Acid rain
    - Global warming
    - Sudden changes in temperature
    - **Harmful, cancer-causing sunlight**
    - Don't Know

8. **Where does most of the garbage in the U.S. end up?**

    - Oceans
    - Incinerators
    - Recycling centers
    - **Landfills**
    - Don't Know

9. **What is the name of the primary federal agency that works to protect the environment?**

    - **Environmental Protection Agency (the EPA)**
    - Department of Health, Environment and Safety (the DHES)
    - National Environmental Agency (the NEA)
    - Federal Pollution Control Agency (the FPCA)
    - Don't Know

10. **Which of the following household wastes is considered a hazardous waste?**

    - Plastic Packaging
    - Glass
    - **Batteries**
    - Spoiled Food
    - Don't Know

11. What is the most common reason that animal species become extinct?

- Pesticides are killing them
- **Their habitats are being destroyed by humans**
- There is too much hunting
- There are climate changes that affect them
- Don't Know

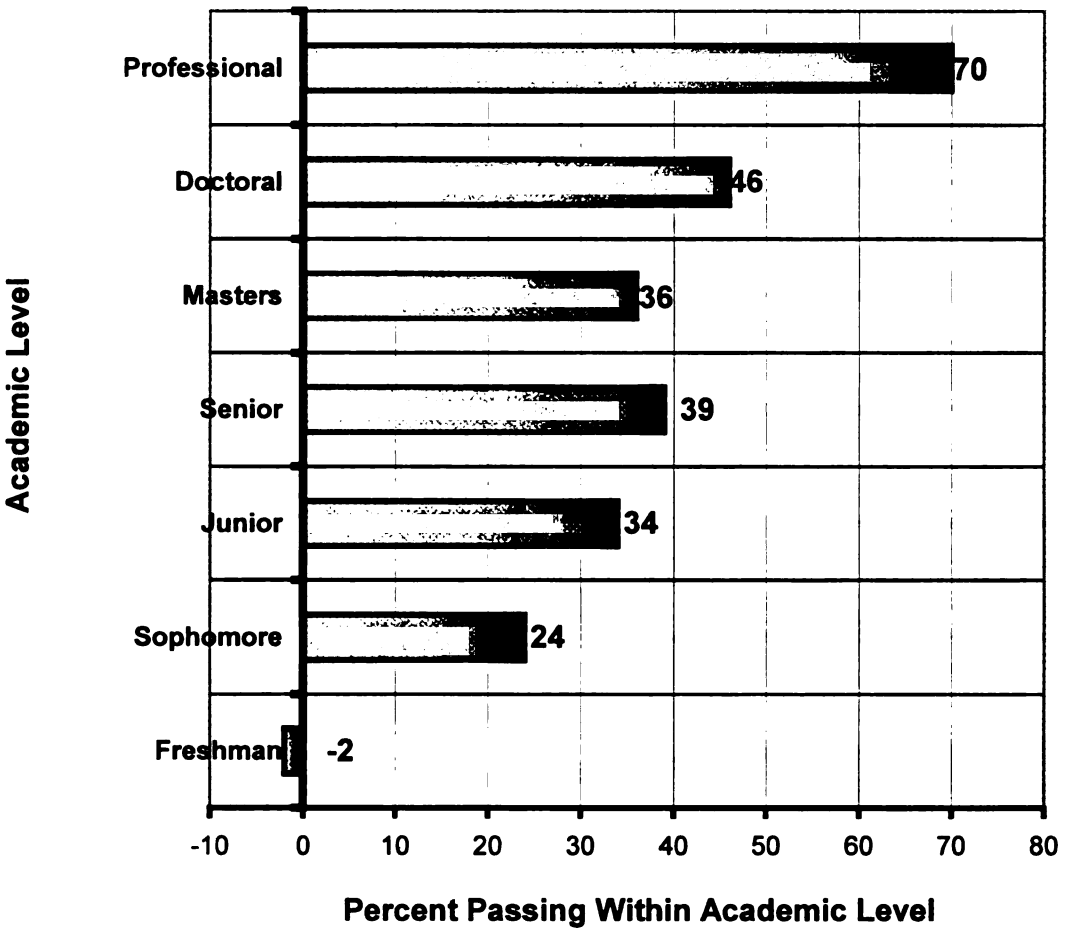
12. Scientists have not determined the best solution for disposing of nuclear waste. In the U.S. what do we do with it now?

- Use it as nuclear fuel
- Sell it to other countries
- Dump it in landfills
- **Store and monitor the waste**
- Don't Know

APPENDIX G

Figure 5.1
Environmental Knowledge and Academic Level
Michigan State University Student Sample

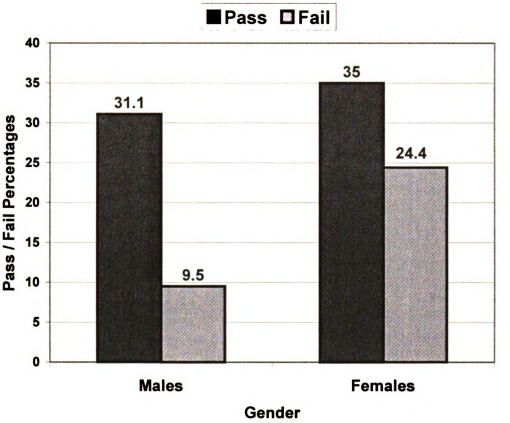
Figure 5.1
Environmental Knowledge and Academic Level
Michigan State University Student Sample



APPENDIX H

Figure 5.2
Environmental Knowledge and Gender
Michigan State University Student Sample

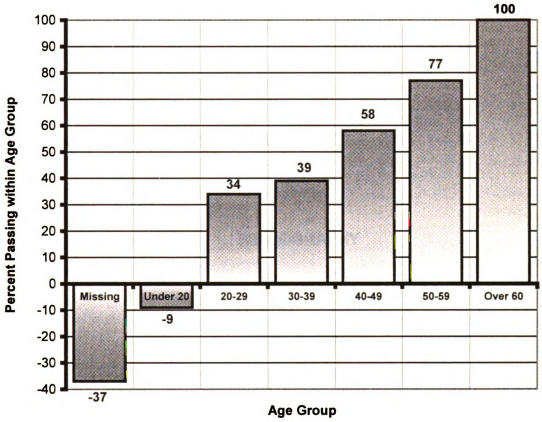
Figure 5.2
Environmental Knowledge and Gender
Michigan State University Student Sample



APPENDIX I

Figure 5.3
Environmental Knowledge and Age Group
Michigan State University Student Sample

Figure 5.3
Environmental Knowledge and Age Group
Michigan State University Student Sample



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