



Adult awareness of environmental degradation caused by technology : a component of Technological, Environmental and Agricultural Literacy (TEAL)
by Gregory Alan Hester

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor Of Education in
Adult, Community and Higher Education
Montana State University
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Abstract:

This study investigated the relationship between adults' attitude toward the environment and their awareness of the detrimental environmental impacts caused by certain commonly used technologies. A total of 396 usable responses for a return rate of 42.4%, were received from a mail survey of managers of Florida community associations (CAs) which are also known as condominium developments. Demographic data was collected along with responses to a modified New Environmental Paradigm/ Dominant Social Paradigm Scale, and the Technological, Environmental and Agricultural Literacy (TEAL) Survey which was developed for this study. Data analysis was conducted to evaluate the instruments and the characteristics of the population.

Both instruments were determined to be reliable and to possess content validity, though the TEAL survey was judged to be deficient in sampling validity. Factor analysis indicated that the TEAL survey measured four dimensions of awareness of harmful environmental impacts of technology which were Energy Literacy, Water Literacy, Waste Literacy, and Pesticide Literacy. The modified NEP/DSP scale was found to measure three factors included in attitude toward the environment which were Belief in Growth and Technology, Relationship between Humans and Nature, and Quality of Life. This was consistent with the findings of previous research using this instrument. Therefore, both instruments were found to have construct validity.

Analysis of the NEP/DSP scale supported the conclusion that a paradigm shift in the general population previously reported by others, is also occurring among adult real estate managers and that the belief that technology will ultimately be developed to solve all environmental problems is not widely held by members of this sample. Attitude scores, among the variables tested were found to be the best predictor of awareness, followed by gender. The relationship between attitude and awareness was found to be complex rather than linear. The majority of CA managers were found to be slightly to moderately supportive of the NEP. However, the awareness levels of CA managers was low. Cluster analysis determined that three distinct groups existed in the population, based on their shared beliefs and awareness levels. These groups were named Complacents, Concerned, and Committed.

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This thesis has been read by each member of the author's committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

This study investigated the relationship between adults' attitude toward the environment and their awareness of the detrimental environmental impacts caused by certain commonly used technologies. A total of 396 usable responses for a return rate of 42.4%, were received from a mail survey of managers of Florida community associations (CAs) which are also known as condominium developments. Demographic data was collected along with responses to a modified New Environmental Paradigm/ Dominant Social Paradigm Scale, and the Technological, Environmental and Agricultural Literacy (TEAL) Survey which was developed for this study. Data analysis was conducted to evaluate the instruments and the characteristics of the population.

Both instruments were determined to be reliable and to possess content validity, though the TEAL survey was judged to be deficient in sampling validity. Factor analysis indicated that the TEAL survey measured four dimensions of awareness of harmful environmental impacts of technology which were Energy Literacy, Water Literacy, Waste Literacy, and Pesticide Literacy. The modified NEP/DSP scale was found to measure three factors included in attitude toward the environment which were Belief in Growth and Technology, Relationship between Humans and Nature, and Quality of Life. This was consistent with the findings of previous research using this instrument. Therefore, both instruments were found to have construct validity.

Analysis of the NEP/DSP scale supported the conclusion that a paradigm shift in the general population previously reported by others, is also occurring among adult real estate managers and that the belief that technology will ultimately be developed to solve all environmental problems is not widely held by members of this sample. Attitude scores, among the variables tested were found to be the best predictor of awareness, followed by gender. The relationship between attitude and awareness was found to be complex rather than linear. The majority of CA managers were found to be slightly to moderately supportive of the NEP. However, the awareness levels of CA managers was low. Cluster analysis determined that three distinct groups existed in the population, based on their shared beliefs and awareness levels. These groups were named Complacents, Concerned, and Committed.

Chapter 1

INTRODUCTION

Background

The meaning of the term "literacy" as perceived by American adults has changed considerably during the decades since World War II. Literacy has traditionally been viewed as an indicator of whether a person has developed the ability to communicate effectively by reading and writing their native language. An individual has been deemed to be functionally literate if they could successfully perform such basic tasks as reading and comprehending a newspaper, or writing a letter which appropriately expressed the ideas they wish to convey.

Until rather recently, most adults also felt that possessing the basic competencies of reading and writing was enough to allow anyone to fully participate in a democratic society. However, the perception of which specific skills an adult must possess in order to be literate has evolved, and the majority of Americans now perceive literacy to include considerably more than just language skills. It is now widely believed that when a person is described as literate, it indicates that they possess a reasonable degree of

proficiency in using higher order thinking skills such as problem solving (Harris, 1970).

As society has become increasingly complex, researchers have attempted to identify the skills adults now require in addition to language arts, to function effectively.

Investigations have attempted to document the need for adults to develop a variety of types of literacy. Three categories of literacy which have recently been the focus of increasing attention are technological literacy, environmental literacy (also know as ecological literacy) and agricultural literacy. For the purposes of this study, these three categories of literacy are referred to as TEAL.

Researchers have identified specific components of each of these categories. One attribute which has been determined to be a significant tenet of each of these literacy types is possessing the ability to recognize potentially harmful impacts to the environment which may result from the use of technology. Although several formal environmental education programs are now attempting to develop this trait in children, it is in fact, a problem which primarily affects adults, since they make far more choices regarding technology use than do children.

Indeed, every adult makes technological choices which have environmental impacts. However, adults who exercise control over substantial tracts of land such as farmers or

professional real estate managers, make decisions which have much greater impacts than an individual homeowner.

In Florida, for instance, managers of real estate developments such as condominiums, can require that all the residents of the development use certain technologies, such as low-flow showerheads. The technological decisions made by one such individual may impact the energy or water consumption of thousands of persons dwelling on hundreds of acres of land. Therefore, it is especially important that these managers develop satisfactory levels of TEAL.

Statement of The Problem

Since the dawn of The Environmental Movement in the early 1970's, adults have generally become more aware of the extensive harmful environmental effects which resulted when technology was used on a large scale without an adequate understanding of its environmental consequences. Extensive media reports about high profile sites such as the Berkeley Pit/Anaconda Smelter Superfund Site with an estimated clean-up cost of over 750 million dollars, have likely been seen or read by the majority of American adults.

However, what remains unclear is the degree to which adults recognize and understand the more subtle environmental impacts of their own individual use of technology. This trait is an especially important component

of TEAL, because profound environmental problems can be caused by the use of technologies such as the gasoline powered automobile, which has become such a major part of the everyday lifestyles of most adults in developed countries.

Because agricultural technologies are used on such large expanses of land, they are frequently blamed for environmental degradation in rural areas (Smith, 1991). However, agricultural technologies such as pesticides, commercial fertilizers and irrigation are also used on millions of urban acres. Pesticides are frequently used on urban lawns at a rate which is up to ten times the rate per acre used by farmers (National Academy of Science, 1980), so the improper use of agricultural technology can be a significant environmental threat in cities too. In fact, the United States Environmental Protection Agency has determined that the majority of pollution problems remaining in the U.S. are caused by numerous widespread "nonpoint sources" (USEPA, 1990) which include not only farms, but cities, suburbs, homes and small businesses as well. Though most of the environmental impacts caused by these individual sources appear at first glance to be insignificant, the damage they cause is substantial nonetheless, when considered collectively.

Despite the need to develop increased adult environmental awareness or TEAL, most formal education programs have focused on K-12 schools. Two notable recent exceptions are programs developed by the Cooperative State Research Extension and Education Services (CSRESS), affiliated with the respective Land Grant Institutions in each state. These programs are "Sustainable Agriculture" and "Sustainable Development". Until approximately a decade ago, Extension education programs focused primarily on economic issues such as increasing profitability with relatively little regard for environmental concerns (Rasmussen, 1989). But these new programming areas take a more holistic approach in that they are attempting to facilitate both knowledge increases as well as attitude changes (USDA, 1995).

In order for these adult education programs to succeed in meeting their objectives, they must overcome some of the barriers that have prevented the behavior changes that other environmental education programs have attempted to promote. Two such barriers which have been identified are an indifferent attitude or lack of concern for the environment, and a lack of knowledge of human impacts on the environment (Gardner & Stern, 1996). Consequently, when adults use legally approved technology in a manner which results in environmental degradation, it is often due to one of these two reasons.

Therefore, an underlying assumption of many environmental education programs is that a person who becomes more informed or develops a higher level of TEAL, will develop more concern for the environment and thus, will become more likely to choose technologies which cause less harmful environmental impacts than persons who do not possess knowledge of those impacts. However, it has been shown repeatedly that possessing knowledge alone is not always sufficient to assure that the desired behavior changes occur. As a result, programs which simply provide knowledge for the learner are seldom successful, especially if the learner has a negative environmental attitude (Gardner & Stern, 1996). But, in cases where the learner has a pro-environmental attitude, learning experiences can be designed to help learners develop behaviors which are compatible with their attitude.

It is important then, to consider the adult learner's attitude toward the environment or overall environmental concern. Attitude in this situation, can be measured by ascertaining the degree to which one accepts or rejects certain critical concepts. Collectively, these beliefs comprise a person's attitude, worldview or paradigm. The first concept is that all environments including Earth have a biological carrying capacity which places limits on the amount of economic growth and development which can occur.

Second, is the idea that in order for humans to survive they must respect the balance of nature and try to live in harmony with it as opposed to pursuing a goal of man conquering nature. The last important component of attitude toward the environment is described as "belief in technology" or BIT (Dunlap & Van Liere, 1978). This is the concept that we need not be concerned about the natural environment, because technology will ultimately be developed to somehow mitigate any detrimental environmental impacts humans have caused before Earth becomes uninhabitable. Therefore, BIT may be a key factor which can influence an adult's reluctance to discontinue using environmentally damaging technologies.

Little is known about adult's awareness of how their technology choices impact the environment, and how it is related to their attitude toward the environment, including the degree of confidence which an individual places in technology's ability to solve environmental problems.

It is also unclear whether the level of awareness of technology-caused environmental impacts has been effectively increased in adults who have participated in traditional continuing education courses offered by Extension and other providers such as Real Estate Schools. For example, do real estate managers who have more formal education or more on-the-job training in property management techniques, have a

greater awareness of technological impacts than less educated individuals? Do more experienced managers have greater concern for the environment than less experienced real estate managers? Are real estate professionals who manage property for appearance and aesthetics literate concerning the use of agricultural technologies such as fertilizer and pesticides on the landscape? Do female property managers possess higher levels of TEAL than male managers? Finally, do adults who have a greater concern for the environment tend to be more aware of the harmful effects of technology?

If adult educators working with this target audience were able to answer these questions they could be better prepared to begin the process of selecting appropriate educational methods to facilitate the development of higher levels of TEAL. Accordingly, in order to design meaningful instructional strategies, adult environmental educators need to consider both the cognitive and affective domains. To plan programs which can be effective in reaching their goal of motivating desired environmental behavior, it is essential that adult educators assess the level of a learner's knowledge as well as their attitude.

Purpose of the study

The purpose of this study was to measure the relationship between attitude toward the environment and awareness of the harmful environmental impacts of technology use. In addition, the study measured the relationship between awareness of the harmful impacts of technology use and the personal descriptors of age, gender, educational level, and years of training or experience in property management.

General Questions to be Answered

(1) What is the general attitude of professional real estate managers toward the environment?

(2) Do professional real estate managers support the concept that technology will be developed to solve all environmental problems humans create before that damage becomes irreversible?

(3) What is the level of awareness by professional real estate managers of the detrimental environmental impacts caused by certain commonly used technologies?

(4) Is there a relationship between awareness by professional real estate managers of the detrimental environmental impacts of technology and their attitude toward the environment including belief in technology?

(5) Does awareness by professional real estate managers of the detrimental environmental impacts caused by technology interact with their personal traits of age, educational level, gender, and years of experience managing real estate?

(6) Among professional real estate managers, can representative groups be identified based on their awareness of detrimental environmental impacts caused by technology and their attitude toward the environment?

Significance of The Study

Numerous experts have reported that we are losing our battle to protect our environment. Problems which are rated as most significant by scientists at the United States Environmental Protection Agency include global warming/climate change, loss of biodiversity, and nonpoint sources of air and water pollution (USEPA, 1990). Each of these problems is due primarily to the cumulative contributions of millions of persons across the nation who seem unaware that their lifestyles create demands for technologies which produce environmental pollution problems. Therefore, the goal of numerous informal educational programs has been to enable learners to increase their understanding of technological impacts on the environment and to develop an attitude which fosters concern and a

willingness to take action to remedy the problem. In short, the goal is to develop citizens who are technologically, environmentally, and agriculturally literate (USEPA, 1991).

Traditional environmental education programs have been based on the assumption that the learner had little knowledge of the relationship between technology and the environment. So, they have tended to focus only on the cognitive domain. These pedagogical methods may not be appropriate for adults, and have generally been unsuccessful at achieving their goal of increased environmental literacy (Hungerford and Volk, 1990). Other educational efforts have attempted to change attitudes by increasing concern or environmental sensitivity, but have achieved almost no long lasting effects (Gardner & Stern, 1996). Since research has shown that knowledge of environmental problems is a required prerequisite to action, and that attitude is also significantly related to environmentally responsible action (Hungerford and Volk, 1990), there may be a relationship between attitude and knowledge.

The researcher located only one study which compared these two variables (Ramsey & Rickson, 1976), but it did report a significant correlation between attitude and knowledge of large scale pollution problems widely reported in the media. However, since this study dealt only with high school students, it could not conclude that such a

relationship also exists in adults. Therefore, one contribution of this study was to determine whether attitude toward the environment is related to awareness of less well publicized pollution problems caused by one's own decisions regarding technology use. This study also evaluated whether the same positive correlation between attitude and knowledge which the authors found in teenagers, exists in mature adults. In other words, the study measured whether adults who have become more aware of the harmful environmental effects of technology, have also tended to develop a more positive attitude toward the environment. If it could be established that these two traits are highly correlated, an adult educator might be able to use the same instrument which is valid for measuring attitude as a valid measure of awareness as well.

A second benefit of the study was to help determine the validity and reliability of a modification of a proven instrument for measuring attitude toward the environment, the New Environmental Paradigm/Dominant Social Paradigm scale (NEP/DSP scale), by testing it on a previously unstudied population. The modified NEP scale had been repeatedly tested on the general population, college students, farmers and members of environmental organizations. The DSP scale had also been tested and proven reliable and valid, but neither had been used on the

population in this study. Since real estate managers must pass certification tests to become licensed, they may have developed an understanding of environmental protection methods for property under their control which may distinguish their awareness level and attitude from members of the general public. Consequently, this study helped to identify characteristics of a population of adult learners which had not previously been measured in this manner.

Another contribution of the study was the development of an instrument, the TEAL survey, to measure a specific component of TEAL, identified as adult awareness or understanding of the harmful environmental impacts cause by certain commonly used technologies. The study helped to establish that the newly developed instrument can produce a valid and reliable measurement of that trait in adults. Since one main goal of adult education is to facilitate decision-making skills and self-discovery in the learner, it is essential to develop techniques and instruments such as the one developed for this study, which can give the educator an increased understanding of how to "learn from the people and start their education where they are" (Adams, 1975, p. 206). Furthermore, this study provides evidence that this instrument can be used as part of an adult learner's process of self diagnosis which was recommended by Knowles (1980) to provide "the highest level of individual

motivation" (p. 227). Adult educators who use appropriate instruments will be better prepared to help the learner determine what steps to take to help the learner move toward the goal of increased TEAL.

In most tradition Extension education programs, instruction has usually been delivered without conducting any type of valid assessment to determine the status of the target audience regarding both attitude and knowledge, prior to entering the educational experience. Therefore, a final benefit of the study is to provide a model which can help Extension educators to make appropriate assessments of adult audiences for designing educational offerings in two major program areas that directly relate to efforts to increase adult TEAL. The program areas of Sustainable Development and Sustainable Agriculture will be profoundly important to furtherance of the mission of the CSREES in the 21st Century. Since Extension programming has been criticized for using a one-size-fits-all approach in the past, this study can help educators to modify methods of instructional design to focus on the needs of the learner, unlike traditional Extension programs, which too often focused solely on subject matter content.

Developing sustainable systems is critical for the future. This will require the development of citizens with high levels of TEAL in both urban and rural adult

populations. Evidence of this is seen in Montana, by the fact that farmers and ranchers control technology use on more than 1/3 of the land, some 60 million acres. While in urban, heavily developed areas, the population is more dense, so the cumulative effects of technology use are concentrated. Consequently, it is imperative that adults in all areas develop an understanding of technological impacts and become informed consumers of technology, aware of the consequences of their choices. The decisions to promote adoption of benign technologies and to reject destructive ones will require democratic participation of large numbers of adults acting in communities. Accordingly, this study has widespread applicability to the field of adult education.

Limitations and Delimitations

The proposed study was conducted under the following restrictions:

(1) All persons in the population sample were asked to participate voluntarily. Since some managers of community associations (CAs), also known as condominium developments, chose not to participate, the sample may not exactly replicate the attitude and awareness levels of the entire population.

(2) No instrument for measuring adult awareness of the harmful environmental impacts of technology was available to the researcher. Therefore, the researcher was limited to basing conclusions regarding this trait to answers ascertained by an instrument developed to serve that purpose in this study. This was accomplished by utilizing the expertise of engineers, faculty and Extension Specialists at the University of Florida. The instrument was delimited to questions measuring the participant's knowledge regarding only those technologies which are commonly used by property managers.

(3) Since the results of the survey were self-reported, the participants may have chosen to provide answers which are not accurate or may not correctly describe the personal traits of the participant. This may have skewed the results of the study.

(4) The study was delimited to only those individuals who were listed by the state of Florida as licensed to manage CAs at the time the survey was mailed in July, 1995.

(5) The study was delimited to only those subjects who manage CAs, in the state of Florida. Persons who manage farmlands, forested lands, or other real property were not surveyed.

Definition of Terms

The following definitions are provided based on the manner in which the term is used with regards to this study.

- (1) Agriculture -- The science of cultivating the soil and of supplying nutrients and water for the purpose of producing plants, which in this study includes only turf and ornamental plants.
- (2) Agricultural Literacy --
Understanding and possessing a knowledge of our food and fiber system. An individual possessing such knowledge would be able to synthesis, analyze, and communicate basic information about agriculture. Basic agriculture knowledge includes: the production of plant and animal products, the economic impact of agriculture, it's societal significance, agriculture's important relationship with natural resources and the environment, the marketing and processing of agricultural products, public agricultural policies, the global significance of agriculture, and the distribution of agricultural products (Frick, 1991, p. 41).
- (3) Attitude toward the environment -- The degree of concern an individual feels for the environment as determined by their worldview or acceptance of a paradigm regarding (a) the balance of nature; (b) mankind's right to conquer nature or exploit natural resources; (c) the biological limits or carrying capacity of an environment; (d) the need for economic growth, prosperity, and progress; (e) belief in private property rights and limited

government regulation; and (f) belief in technology. The Two extremes of attitude are represented by the New Environmental Paradigm (NEP) and the Dominant Social Paradigm (DSP) (Dunlap & Van Liere, 1978).

- (4) Belief in Technology (BIT)-- An acceptance of the idea that humans will always through the application of science, be able to develop technology which will be able to prevent or mitigate any harmful effects to our environment before the damage becomes irreversible or our ability to survive as a species is jeopardized. BIT is one component of attitude (Dunlap & Van Liere, 1978).
- (5) Community Association -- A legally organized group of owners of condominiums who jointly own common areas of property in the same building or on the same grounds.
- (6) Dominant Social Paradigm (DSP) -- an attitude or worldview widely accepted by the American public after World War II. It is characterized by the following set of beliefs: (a) Humans have a right to use natural resources, because they were created for human benefit; (b) the balance of nature will not be upset by human intervention; (c) the biological limits or carrying capacity of

an environment can be overcome by the application of better technology; (d) it is necessary for our economy to continue growing to insure prosperity and progress; (e) the government must not interfere with private property rights by adopting environmental regulation; and (f) technology will be devised to solve any human-caused environmental problems (Pirages & Ehrlich, 1974, p. 44).

- (7) Dominant Social Paradigm Scale (DSP Scale)-- An instrument developed to measure attitude, specifically the degree to which an individual accepts the beliefs which constitute the DSP (Dunlap & Van Liere, 1984).
- (8) Environment --The natural world in which all living creatures exist including the air, water, soil, all plants and animals (McKinney & Schoch, 1996).
- (9) Environmental Literacy --
The capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems. This includes having an understanding of the relationships between natural and social systems, the unity of mankind with nature, technology and the making of choices, and developmental learning throughout the human life cycle (Disinger & Roth, 1992, p. 2).

(10) Environmental Movement -- The shift in the American population's view of their relationship with the environment. This change began around the time of the First Earth Day on April 22, 1970. It has these goals:

- (a) the safety and good health of individuals, including their psychological well-being as affected by the natural environment
- (b) the long range survival and welfare of society, including the life-supporting environment on which these depend,
- (c.) the achievement of a richer and fuller life, including desirable environmental characteristics (Odell, 1980, p. 5).

(11) Literacy-- Being literate which is having the ability to read and write, and having the ability to respond to the problems of everyday life (Harris, 1970).

(12) Nonpoint Source Pollution -- degradation of air or water due to an accumulation of numerous contaminants from widespread, difficult-to-pinpoint sources over a large geographic area (USEPA, 1991).

(13) New Environmental Paradigm (NEP) -- An attitude or worldview which began to become more widely accepted by the American public after the start of The Environmental Movement. The NEP is

characterized by the following set of beliefs:

(a) Humans have no right to exploit natural resources, because humans exist as a part of nature not the conquerors of nature; (b) the balance of nature can be upset by human intervention; (c) the biological limits or carrying capacity of an environment cannot be exceeded; (d) it is necessary to place limits on economic growth and to develop a steady state economy; (e) the government must be allowed to restrict private property rights to protect the environment which sustains life; and (e) humans cannot depend on technology to solve every environmental problem (Dunlap & Van Liere, 1978).

(14) New Environmental Paradigm Scale (NEP Scale)-- An instrument developed to measure attitude, specifically the degree to which one accepts the beliefs which constitute the DSP (Dunlap & Van Liere, 1978).

(15) NEP/DSP Scale -- An instrument which modified and combined both the NEP Scale and the DSP Scale to measure attitude, containing statements referencing beliefs in the DSP and the NEP (Kuhn & Jackson, 1989).

(16) Sustainable Agriculture--

An agriculture that can evolve indefinitely toward greater human utility, greater efficiency of resource use, and a balance with the environment that is favorable both to humans and to most other species (Harwood, 1990, p. 18).

(17) Sustainable Development --

Development that focuses on making social, economic, and political progress to satisfy global human needs, desires, aspirations, and potential without damaging the environment (McKinney & Schoch, 1996 p. G-13).

(18) TEAL -- An acronym for technological, environmental, and agricultural literacy.(19) Technology --

The human activity in which physical means that extend human capabilities are used to purposefully address the satisfaction of human wants and needs (Dyrenfurth and Kozak. 1991, p. 152).

(20) Technological Literacy --

The possession of broad knowledge of technology together with the attitudes and physical abilities to implement the knowledge in a safe, appropriate, efficient, and effective manner. Technological literacy requires that one be able to perform tasks using the tools, machines, materials, and processes resulting from technology (Dyrenfurth, 1987, p. 22).

Chapter 2

REVIEW OF LITERATURE

Literacy

The concept of "literacy" is multi-faceted and difficult to define. The complexity of the task of accurately describing the many aspects of literacy was noted by Brandt (1985, p. 128).

It is tempting to observe in an overview how scholars working elbow-to-elbow on the same problem rarely seem to converse with each other, or how the diversity of their method--from broad political speculation to detailed ethnographic description--wards off any certain and truly interdisciplinary conclusions about the nature of literacy.

Despite this widespread disagreement among disciplines as to what prerequisites are essential to be a literate adult, possessing two fundamental skills are unquestionably mandatory. In order to be literate an adult must be capable of both reading and writing at an effective level. Possession of these skills is the essence of literacy as it is traditionally associated with the field of adult education (Brandt, 1985).

Numerous programs designed to teach literacy to adults across the United States are conducted by a variety of institutions, including colleges, high schools, Job Corps

Centers, prisons, and others. These programs provide Adult Basic Education (ABE), which focuses on developing an adult's ability to read and write adequately as measured by a standardized General Equivalency Diploma (GED) test. Though state minimum scores for earning the GED vary, passing this test has long been viewed as proof that an adult has developed sufficient language skills to be considered literate.

However, the belief that the development of communication skills alone is sufficient preparation for an adult to become literate has often been disputed. In fact, even when discussions of literacy have been limited to only these skills, perceptions of literacy have varied greatly. Van Dyke (1987) observed that:

What it means to be literate---even what it means to read and write---varies according to period and culture. Roman Orators, for instance, could be literate in spoken language; medieval scribes, literate by profession, could write the letters of the alphabet, but could not comprehend what they wrote (p. 2).

Accordingly, literacy as conceived by the American public is a trait which can no longer be adequately explained only in terms of one's ability to recognize and reproduce letters and words. Harris (1970) found that for an adult to be considered literate they had to possess "the ability to respond to practical tasks of daily life" (p.10).

Pattison (1982) also took a nontraditional view of literacy and referred to the idea that language skills should be the sole basis for determining whether an adult is literate as a fallacy. He noted that reading and writing do not constitute literacy, they are only the means of manifesting it. He explained that "literacy more fundamentally, is about consciousness of the problems posed by language" (p. vi). He advocated describing literacy more in terms of encompassing an understanding of what possibilities that communication skills opened for adults.

Oxenham (1980) had earlier referred to literacy as "simply a technology invented for certain practical purposes...the technology of the Intellect" (p.84). And though he felt it was the one most important tool or technological resource which has the power to create opportunities to develop skills in reasoning and increased self consciousness, it was not the one and only key to success in life.

This rather common assumption regarding literacy, that reading and writing skills in and of themselves are able to fully empower adults, was also debunked by Van Dyke (1987):

If the traditional definition of literacy has been challenged, so have common ideas about its effects. In particular, scholars tell us, literacy is not inherently liberating. That is, increases in the ability to read and write do not always correlate with individual empowerment, economic development, or democratic government (p. 3).

This idea was also criticized by Graff (1979) who described it as "the literacy myth" (p. 304). He found that there was no significant relationship between attaining only the traditional literacy skills of reading and writing, and attaining increased economic status. He concluded that other factors including the development of verbal communication and reasoning skills were vital to allow adults to function effectively in society.

Therefore, the concept of literacy has changed from one in which it was seen as a specific set of skills that one could obtain to become literate for the rest of their life, to one which sees the task of being literate as an ongoing dynamic process. This concept was described by Greene (1982) "literacy ought to be conceived as an opening, a beginning, never a fixed end" (p. 326). A current view of literacy then, includes far more than basic language skills. In order to fully participate in our society, in other words to be a literate adult in the information age, one must develop a variety of skills. This process is lifelong and involves developing understanding and proficiency in a variety of types of literacy.

Due its inherent ambiguity, literacy has been the subject of numerous studies and many definitions of literacy types have been developed. Several researchers have made

efforts to quantify those skills which are deemed to be essential for adults to lead a fulfilling and productive life, and to document the need for including them in an adult education program. The focus of this study is one particular aspect which has been identified as important component of three types of literacy, the ability of adults to recognize the harmful environmental impacts of commonly used technologies. This skill has been deemed to be vital for the development of technological, agricultural and environmental literacy (Devore, 1986; Frick, 1991; Roth, 1992).

Environmental Literacy

The United States Congress officially recognized that developing environmental literacy was worthwhile when it passed the United States Environmental Education Act which President Bush signed in 1990. Implementation of this law has been directed by the Environmental Protection Agency which produced a mission statement proclaiming that "As improvements in environmental protection become dependent upon the activities of individuals so grows the need for an environmentally literate citizenry" (USEPA, 1991, p. 3). The EPA did not define environmental literacy.

But, Disinger & Roth (1992) found that although the term environmental literacy had been used for more than 20

years, it still lacked precision. They described the term as one which draws its meaning from six major content areas: "environmental sensitivity; knowledge; skills; attitudes and values; personal investment and responsibility; and active involvement" (p. 2).

Roth (1992) conducted a Delphi study in conjunction with the Committee on Environmental Education of the American Society for Testing and Materials (ASTM) to attempt to define and set standards for measuring environmental literacy. One conclusion of the study was a general definition of environmental literacy:

The capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems. It includes an understanding of the interrelationships between natural and social systems, the unity of mankind with nature, technology and the making of choices, and developmental learning throughout life (p. 12).

Roth distinguished between individuals who were only environmentally aware and those who were environmentally literate. He concluded that environmental literacy includes an action perspective, in that all environmentally literate citizens "should be able to demonstrate in some observable form what they have learned--their knowledge, skills acquired, disposition toward issues and the like" (p. 25). He further reported that environmental literacy exists as a continuum with different levels of proficiency. The three

levels of environmental literacy in ascending order are nominal literacy, functional literacy and operational literacy. The highest level identifies a person who:

has moved beyond functional literacy in both the breadth and depth of understanding and skills who routinely evaluates the impacts and consequences of actions: gathering and synthesizing pertinent information, choosing among alternatives, and advocating action positions and taking actions that work to sustain or enhance a healthy environment (p. 26).

This level of literacy is the goal of most environmental education programs such as those supported by the EPA as part of the National Environmental Education Act.

The ambiguity over what makes a person environmentally literate is illustrated by two comments made by William Reily, the former director of the USEPA. In 1990, he stated that "the public...has come to an unprecedented awareness of the threats to our environment" (Reily, 1990, p. 4). Just two years later, he noted that the amount of used motor oil Americans dumped into landfills or poured into storm drains in 1988, was equal to 16 Exxon Valdez oil spills (Reily, 1992, p. 37). The failure of so many persons to take appropriate action in disposing of waste motor oil is evidence that far too many adults are still not environmentally literate. Similarly Hungerford, Litherlan, Peyton, Ramsey, Tomera and Volk (1985) felt that motivation to take action is required for environmental literacy.

The environmentally literate citizen is able and willing to make environmental decisions which are consistent with both a substantial quality of human life and an equally substantial quality of the environment. Furthermore, this individual is motivated to act on these decisions either individually or collectively (p. 1).

Therefore, an adult who does not act after becoming aware of environmental problems is not fully literate.

Science literacy differs from environmental literacy in that it is more focused on understanding basic natural phenomena, the laws of the physical and biological sciences which control our universe rather than the technology we have created by our understanding of how to apply science to solve problems. However, though science literacy is less broad in scope, both include action as a part of literacy.

Scientifically literate persons are objective, open-minded and questioning. Their knowledge and inquiry skills make it possible for them to interpret science-related information presented in the popular media (newspapers, television, etc.)...and most of all they are critical thinkers and decision makers--they ask questions, seek answers, study consequences, and act on the basis of the best information available (Reichard, 1985, p. 110).

Agricultural Literacy

The National Research Council issued a report on agricultural literacy (NRC, 1988) which acknowledged that "most Americans know little about agriculture... particularly, its link to human health and environmental quality" (p. 9). This concept was later evaluated by Frick

(1991) in a Delphi study which produced a definition of agricultural literacy.

Agricultural literacy is understanding and possessing a knowledge of our food and fiber system. An individual possessing such knowledge would be able to synthesis, analyze, and communicate basic information about agriculture. Basic agriculture knowledge includes: the production of plant and animal products (divided into separate concept areas in the concept questionnaire), the economic impact of agriculture, it's societal significance, agriculture's important relationship with natural resources and the environment, (divided into separate concept areas in the concept questionnaire), the marketing and processing of agricultural products, public agricultural policies, the global significance of agriculture, and the distribution of agricultural products (p. 41).

Five-hundred ninety concepts were submitted for potential inclusion in a comprehensive definition of agricultural literacy. Two of the 11 agricultural literacy concept areas which were identified in this study are closely related to the concept of environmental literacy. They are agriculture's important relationship to the environment and agriculture's important relationship with natural resources (p. 45).

These concept areas were further refined into sub-areas. The sub-areas contained in the subject area of agriculture's important relationship with the environment are:

- (1) The agriculturalist's role in protecting the environment

- (2) The effect of agriculture on the environment
- (3) Opinions and perceptions
- (4) Chemicals
- (5) Positive effects of agriculture on the environment
- (6) Negative effects of agriculture on the environment
- (7) Environment's close relationship with agriculture

The sub-areas contained in the subject area of agriculture's important relationship with the natural resources are:

- (1) Conservation of natural resources
- (2) Sustainable agriculture
- (3) Stewardship of agriculture
- (4) Pollution and depletion of our natural resources
- (5) Co-dependent relationship between agriculture and natural resources
- (6) Importance of natural resources for agriculture

Accordingly, several ideas which Frick identified during the process of defining agricultural literacy are concepts which are components of technological and environmental literacy as well. These include the notion that agriculture technologies have an impact on the environment which can be negative, and that it is essential that sustainable agriculture systems be developed which maintain water quality and the balance of oxygen and carbon dioxide in the atmosphere for plants and the human race to

survive (p. 49). It is also necessary in order to be agriculturally literate that one understands "the importance of human being's role (technology) in managing our natural resources to provide food, fiber, and shelter" as well as other human needs (p.59).

Frick (1991) indicated that some participants in defining the term agricultural literacy promoted the belief that "ranch and farm operators are very conscientious and concerned about the environment" (p. 47). However, other studies have tended to contradict this assertion. Albrecht, Bultena, Hoiberg, and Nowak (1982) surveyed 441 farmers in Iowa in 1979, and 1980, to measure their attitude toward the environment. They noted that previously "research has consistently shown farmers to be less environmentally aware and concerned than nonfarm populations" (p. 41). Their study also found that the general public was significantly more concerned about the environment than the farmers they surveyed.

Walter & Reisner (1992) discovered that significant numbers of incoming freshmen, especially those from urban areas were either unwilling or unable to express an opinion on a wide range of environmental or conservation issues. They concluded that "even agriculturally literate students could profit from challenges to their perceived beliefs about agricultural practices and policies" (p. 19).

A Kansas State University study of swine producers found that less than 1/2 realized that nitrates in hog waste were an environmental problem, and only 1/4 were concerned about phosphorus in hog waste though it is the most significant nutrient increasing algal blooms and eutrophication of lakes (Riechert, Tokach, Goodband, and Nelssen, 1995, p. 2). Bruening (1991) concluded that the level of agricultural literacy among farmers was less than desirable. Padgitt and Petzelka (1993) agreed:

Overall, farmers are limited in their awareness of farm specific environmental problems...research reveals that, while farmers are generally aware of environmental and sustainability problems, not all are mindful of or believe the specific problem relates to them. More efforts are needed to increase farmers awareness of environmental problems on their land (p. 277).

Agricultural literacy levels are also inadequate among urban populations as well. The Environmental Studies Board of the National Academy of Sciences, found that "homeowners use ten times more pesticide per acre than farmers-about five to ten pounds per acre" (National Academy of Sciences, 1980, p. 2). This results in a total of some 70 million pounds being applied annually to American lawns.

These studies clearly indicate that agricultural literacy needs to be increased in both urban and rural adult populations, including raising awareness of the potential environmental harm caused by agricultural technologies.

Technological Literacy

Scholars have for decades realized that technology's interaction with the environment needed to be better understood by adults. Carson (1962) observed that many of the most alarming environmental problems which began to appear in the second half of the twentieth century developed because technology had been placed "indiscriminately into the hands of persons largely or wholly ignorant of their potentials for harm" (p. 13). The concept of how technology shapes our culture and the need for its control was also recognized by Skinner (1972):

We are all controlled by the world in which we live, and a part of that world has been and will be constructed by men. The question is this: Are we to be controlled by accidents, by tyrants, or by ourselves in effective cultural design (p. 149).

He recognized that for the latter to happen, it would require that technological literacy, although he never referred to it by that term, be developed in significant numbers of adults. Waks (1987) described the need for a technologically literate critical mass to ensure that political decisions reflect a cross section of informed democratic participation. He concluded that technological literacy is absolutely a "prerequisite of liberty and equality in a technology dominated age" (p. 366). Technological literacy then, is a concept far more encompassing than just understanding how to use a computer.

Consequently, the task of defining technological literacy has long been recognized as a very difficult challenge. "Our Search for a universal operational definition of technological literacy is probably futile" (Van Dyke, 1987, p. 4). However, that has not stopped educators from attempting to reach consensus on the term.

The National Technological Literacy Conference defined the term as "Understanding the technological and scientific forces shaping our lives and being able to act on this understanding for our personal welfare and the common good" (Steele, 1987, p. 738). Four years later the National Council for Technology Teacher Education expanded the concepts in more detail and devoted their entire 1991 Yearbook toward refining the many facets of this complex idea. They determined that technological literacy is based on the following components:

A. Democratic needs since:

- (1) Our society is based on knowledge and knowhow.
- (2) Citizens require certain forms of literacy to function effectively as free responsible members of society.
- (3) People have a right to have a voice in determining their future.

B. Nature of life in society since:

(1) Survival depends on our capacity to apply rationality in solving problems within the environment.

C. Dehumanization and loss of control since:

(1) Technology is a powerful force which dehumanizes life by placing increasing demands on humans which have grown beyond our understanding and control.

(2) Technological decisions which control lives are often made by experts at a distance rather than with input from locals.

D. Impacts of technology since:

(1) Technology affects individuals, specific cultures and society in general, as well as the environment that makes our lives possible.

Devore (1984, 1987) described technology generally as the application of resources (time, tools, materials, and energy) by humans toward solving problems. Dyrenfurth and Kozak (1991) took this concept a step further to view technology as a human activity using physical means that extend human capabilities to satisfy human wants and needs (p. 152). In either view, basic technological literacy requires that one be able to perform tasks using the tools, machines, materials, and processes resulting from technology

(Dyrenfurth and Mihalevich 1987, p. 22). Todd (1987) proposed that technological literacy like environmental literacy, exists as a continuum with different levels of development and problem solving abilities. In Todd's model, the highest level of literacy is technological criticism (p. 775). He viewed a person who had attained this level of skills as a valuable community member who could collaboratively make technology choices.

Devore (1987) agreed and reiterated that the increasing urgency of developing sustainable systems will require that citizens be more involved in the participatory nature of community decision-making. He felt that technological literacy will be a basic necessity and that acceptance of greater individual responsibility along with continuing personal growth and lifelong learning will be vital. He also viewed the present dysfunctions of our society as the direct result of the inappropriate use of technical means that are rapidly depleting Earth's nonrenewable resources. He warned that continuing to place the decision-making authority for the use of these technical means into the hands of a few persons which he described as 'the elite', is a mistake:

a technologically illiterate citizenry will promote the demise of democracy and place in control an elite group of people who, by their knowledge and know-how, will control the technical systems and thereby the possession of public and private life nationally and internationally as well (p. 712).

Fleming (1989) agreed that adults should develop the higher order thinking skills required to be critical of technology. He argued that literate persons should realize that no technology is completely understood and that we too often depend on someone else to inform us about technology rather than acting by examining both the pros and cons to "perceive the underlying political and social forces driving the development of technology" (p. 394). He used the analogy of elites, cattle barons who successfully opposed the use of a very simple technology, barbed wire fences for decades by the counter elites, farmers. Ultimately, acceptance of this technology aided in the downfall of cattle companies as well as the cow culture which had developed on the western plains. The results were that after a decision regarding technology was made in a democratic manner it aided in the emergence of a more diverse society and economy based on grain production and other farming ventures rather being totally dependent on the sole commodity of beef. He lamented that today many people "feel that whatever they have to say about technology will likely have little impact, but this sense of impotence in a democratic society must be addressed" (p. 403).

The need for higher levels of technological literacy and more participation in technology choices was also

promoted by Miller (1986) who reminded us that a technologically literate person "should understand that in democratic societies, citizens have some say about which technologies should be advanced and which should be restrained" (p. 200). Likewise, Winner (1977) stressed the importance of citizen participation in the setting of limits on environmentally harmful technologies and looked forward to the time when America, in reflecting on the age in which we realized the importance of developing technological literacy, would remember it as "the time when we came to our senses" (p. 13). Winner (1986) later observed that even "choices about supposedly neutral technologies...are actually choices about the kind of society in which we will live" (p. 375). Ferre' (1988) concurred and further explained that:

even private decisions on technology, when they have profound effects on persons now living or in future generations and when they have significant impact on the environment, are rightly subject to citizen participation. Just as your freedom to smoke ends where my lungs begin so an electric utility's plan to erect a smokestack ceases to be merely private where my view, property values and health are affected (p. 87).

Hull (1990) analyzed the sociotechnical dimension of technological literacy and came to a similar conclusion. He stated that significant changes in technology use always have had unintended and unforeseen environmental consequences. Thus, decisions about technology are always

made within a context of uncertainty. Increasing levels of adult technological literacy can reduce this uncertainty.

Devore (1986) also argued that only citizens who understand technical systems can make intelligent decisions about their use or the need to replace them with systems which are more appropriate. He urged that the perpetuation of "problem plagued technologies" (p. 203) be terminated through knowledge as well as the analysis, synthesis, and application of values.

Fielder (1992) pointed out that there are some cases where technologically literate persons have been able to bring about pro-environmental actions such as preventing the dumping of toxic waste near populated areas, by actively challenging the decision making institutions which those persons regarded as captives of technological interests.

But, for the most part the degree of participation by citizens has been minor. Sclove (1992) observed that each of us has made a contribution toward building the world which exists. He argued that our citizenry must become more critically involved in choices about technological practices and faulted the current system or technological order that he described as an arbitrary, anti-democratic social force which "excludes citizens from anything but a trivial role and often raises questions publicly only after important decisions have already been made elsewhere" (p. 153).

This conclusion was also reached by Postel (1994) who found that citizens have not assumed this much-needed control of technology. Rather, we have been content to allow economics to serve in the role of decision-maker for us.

As a society we have failed to discriminate between technologies that meet our needs in a sustainable way and those that harm the earth. We have largely let the market dictate which technologies move forward, without adjusting for it's failure to take proper account of environmental damage (p. 41).

Bugliarello (1990) believed that our inability to use technology in a environmentally benign manner is due to the fact that technology is shackled to inadequate anachronistic social structures. He discussed the importance of focusing on personal habits and attitudes as well as knowledge in the development of technological literacy. He stated that most of all technological literacy is the "development and empowerment of a new set of ethical concerns and responsibilities" (p. 190). Such empowerment could become "the best filter we possess against human folly" (Hardin, 1985, p. 2)

In summary, numerous scholars have described technological literacy as a highly complex concept which will be vital to insuring human survival in the future. The concept has evolved from one which basically included developing an understanding of tools and their use, to one that was described by Devore (1991) as focused on a new

vision of the nature and characteristics of technical means in the social order. He envisioned a new widespread technological literacy based on an:

Enabling ethic grounded in the understanding that technological systems can be designed to be compatible with the living Earth and that the design and development of appropriate technical means will enable human beings to create sustainable quality futures (p. 274).

The Need for Awareness of Technological
Impacts on the Environment.

Thirty five years ago Carson (1962) reflected on the history of humans attempting through technology to conquer nature and warned that such a policy held dire implications for our future.

As man proceeds toward his announced goal of the conquest of nature, he has written a depressing record of destruction, directed not only against the earth's inhabitants, but against the life that shares it with him. The history of the recent centuries has its black passages---the slaughter of the buffalo on the western plains, the massacre of the shorebirds by market gunners, the near extinction of the egrets for their plumage. Now to these and others like them, we are adding a new chapter and a new kind of havoc (p.3).

Carson's examples were of situations where the impacts of technology use could be easily observed. Her predictions of new kinds of havoc include many that unfortunately, are not so readily apparent. Some of these are occurring on a global scale in ways so subtle that they are hard to measure. In an

attempt to provide evidence that the need for adults to develop adequate levels of TEAL is growing increasingly urgent, Durning (1990) thoroughly examined the various documented problems and provided a ranking of the world's "most tenacious and threatening environmental challenges" (p. 40). He concluded that each of these problems was caused by technology use. He chose as the one which should be our highest priority, the threat of future climate changes due to "the byproducts of burning massive quantities of fossil fuels" (p. 40). He ranked second the waste disposal crisis and the enormous energy squandered by our throwaway society. Third was the urgent need to adopt better methods of water conservation and protection.

The United States Environmental Protection Agency also convened a panel of the nation's most distinguished scientists to study the severity of various environmental threats and provide direction toward addressing them. They generally concurred with Durning's rankings which all fall under the broad category of "nonpoint source pollution". However, the panel also included runoff of pesticides from both farms and lawns. They also ranked as a high priority the destruction of habitat by expanding agricultural use and urban development leading to species extinction and loss of biodiversity (USEPA, 1990). Again, all of the problems identified are caused by technology use.

Others also warned of the urgency of recognizing the extent and the severity of the problems. Malone & Corell (1989) pointed out that "the capacity of the global life-supporting system to sustain a technologically advanced and exponentially expanding civilization is likely to collapse within the foreseeable future" (p. 7).

Orr (1992) noted that our knowledge of how to do vast and risky things has far outrun our ability to deal with the consequences of such endeavors. As a result, we have created what he called "monsters of technology" (P. 38) for which no one takes responsibility:

Whether technology is beyond human control there can be no question, that it is now the preeminent fact in modern societies. Whether it can be controlled and harnessed to the long-term benefit of humanity is the question of our civilization (p.39).

Orr reminded us that there is not one single example in history of a society which has been both technologically dynamic and environmentally sustainable.

Hawken (1993) declared that transforming our society into one which employed only sustainable systems of agriculture and development, is the greatest gift that we can give to our children and grandchildren, the gift of a future. He described the value of such a gift as inestimatable. He further explained why he felt that increasing TEAL in individuals can't wait any longer:

Most global problems cannot be solved globally because they are global symptoms of local problems with roots in reductionist thinking that goes back to the scientific revolution and the beginnings of industrialism. We have operated our world for the past few centuries on the basis that we could manage it if not dominate it, with respect to living systems. We have sacrificed the harmonious development of our cultures for enormous short term gains, and we now face the invoice for that kind of thinking: an ecological as well as a social crisis (p. 201).

Sale (1995) agreed that the term crisis was not too strong to use in describing the present state of our society and each individual's impact on our environment. "Tinkering with that law or regulation, or even stopping that dam or this clear-cut is not going to make any fundamental change necessary. Nothing less than changing the way we live is going to save the planet" (p. A-2).

In summarizing the importance of TEAL, Orr (1992) explained that:

There are no easy answers to issues posed by technology and when the times comes that we decide to confront some of them, we will find that the widespread technological illiteracy will make it extremely difficult to find acceptable solutions. We have become addicted to technology that locks us into a system (capitalism) and behavior patterns which impose long term costs for short term gains (p. 15).

Horton (Fellenz and Conti, 1990) agreed that we are certainly facing a dilemma and that the process of making changes needs to begin now:

We are not going anywhere with these short range goals; they tend to reinforce the system...We have to understand our interrelationships in a lot of ways. For example, we banned DDT in this country but send it to Latin America where they spray it on fruit and send it back for us to eat (p. 17).

But he felt that it is not necessary to abruptly abandon our present lifestyle. His advice was "I think there has to be some sort of compromise there between selling your soul and survival" (p 15). Therefore, numerous scholars feel that we have reached an important point in history where delaying the needed discussions of how communities can find long-term solutions to environmental problems may have a profound impact on our very survival.

We stand where two roads diverge. But unlike the roads in Robert Frost's familiar poem, they are not equally fair. The road we have long traveled is deceptively easy, a smooth superhighway on which we progress with great speed, but at it's end lies disaster. The other fork---the "one less traveled by"---offers our last chance to reach a destination that assures the preservation of our earth. (Carson, 1962, p. 276).

The debate among educators then, will be over how to help adult learners become convinced that the less traveled road is the best choice.

Traditional Environmental Education

The majority of Americans say they are willing to change their consumptive habits, and limit econmoic development if it will protect the Environment (Gilbert, 1990; Heimlich, 1992). Likewise, over half of the Canadian

adults agreed in a survey conducted by Reid (1989) with the statement that "drastic changes in lifestyles are needed to help alleviate environmental degradation" (p. 10). But, Reid concluded that people lack the knowledge needed to play an effective role in finding appropriate solutions.

Gigliotti (1990) drew a similar conclusion. He noted that America has a "citizenry that is emotionally charged but lacking in basic ecological knowledge" (p. 9). The solution would seem to be then, to provide that knowledge to the public and thereby, solve our environmental problems. This is essentially the approach which has been taken by traditional environmental education programs. Kirts (1990, p. 34) declared that environmental education should:

- (1) examine the scope and complexity of environmental problems and the need to develop critical thinking and problem-solving skills and the ability to synthesize data from many fields.
- (2) stress the need for active citizen participation in addressing environmental problems and preventing new ones.
- (3) enable learners to play a role in their learning experiences and provide an opportunity for them to make decisions and accept consequences.
- (4) be a lifelong process.

But, most environmental education programs have not been conducted in such a manner, and they have generally failed to achieve their goals. Disinger (1991) described this lack of success:

Working toward positive behavioral change with school children has produced modest gains, but finding ways of changing the environmental behavior of the adult population and of society in general, has been more difficult. In the main, the environment has not been identified as a high priority by American society...Though national opinion polls consistently show high rankings for environmental concerns, the adult public's first thoughts about the environment appear to be in terms of aesthetics and amenitiei values, with secondary concern about specific environmental problems at local, rather than national or global levels...A number of studies have indicated that public environmental knowledge remains low, despite increasing interest (p. 2).

Evans (1988) argued that formal educational programs were inadequate for increasing understanding of "man's impact on the global environment" (p.136), because they tended to only teach about natural environments which are becoming increasingly rare, those undisturbed by technology. These don't allow the learner to develop an an appropriate understanding of how extensively humans through technology have impacted the natural world. Others though, feel that the problem is broader and is institution based.

As Darkenwald and Merriam (1982) explained "adult education as an enterprise, a profession, and a movement cannot be fully understood apart from the organizations that have nurtured it and given it definition and direction" (p 151). Therefore, in judging the success of environmental education one must consider the institutions providing the programs.

Colleges and universities provide many learners with their only exposure to a formal environmental education course. Keiss (1970) summarized one of the most frequently voiced criticisms of modern universities as institutions dominated by an autocratic system which emphasized research instead of learning. This research is often financed and promoted by industrial forces whose business interests may "threaten man's environment...or reduce his capacity to participate in decisions which involve his survival or the survival of mankind" (p.2). Her criticism was aimed at much of the agricultural research which is funded by corporations with a vested interest in the status quo rather than new sustainable methods which might require the use of a smaller volume of the products they sell.

Orr (1992) also declared that much research conducted by universities is:

aimed to further the project of human domination of the planet. Considerably less of it is directed at understanding the effects of domination. Less still is aimed to develop ecologically sound alternatives that enable us to live within natural limits. Ultimately our survival will depend as much on rediscovery as on research (p. 151).

Finger (1989) blamed part of the failure of traditional formal environmental education on the tendency of institutions to inhibit instructors from taking positions of advocacy. He warned that:

We should take this into account when planning or institutionalizing environmental adult education, in particular because, until now, more formal adult education has mainly provided information or technical knowledge about the environment and its destruction. But such knowledge is at most a detail in and not the driving force behind the process of adult environmental education (p. 29).

One such institutional educational organization which has always expected instructors to remain neutral providers of information is the Cooperative State Research, Education, and Extension Service (CSREES). Formerly the Cooperative Extension Service (CES), it was reorganized in 1995. Darkenwald and Merriam (1982) described the traditional role of the old CES as a system in which "much Extension work involves information giving and technical assistance rather than education in the stricter sense of the term" (p. 165). Rasmussen (1989) explained that the goals of the CES were quite narrowly focused and that over the years, Extension educators had helped farmers to adopt new practices based almost exclusively on economic reasons. Ironically, some practices recommended by Extension, such as storing gasoline in underground tanks to reduce evaporation losses, have ultimately contributed to the current environmental problems. Some practices that were selected to help farmers remain economically viable were not sustainable and have led to environmental degradation requiring expensive clean-ups.

The new CSREES has reconfigured its mission into one which is much broader than that of the CES. "The CSREES mission emphasizes partnerships...and promotes informed decisionmaking" (USDA, 1995, p. 1). It "focuses on critical issues affecting peoples daily lives and the Nation's future" (p. 2). Two of the major new program areas on which it will conduct educational programs are "sustainable agriculture" and "sustainable development" which take a holistic view in making recommendations. However, some feel that it is also time for Extension educators to rethink the relationship of higher education institutions and organizations such as the CSREES to human survival. Doing so will require leadership based on both vision and courage. Orr (1992) proclaims that "In the mounting battle for a habitable planet it is time for educators, college and university presidents, faculty and trustees to stand up and be counted" (p. 152).

Several additional explanations of why environmental education has not succeeded have been developed in recent years. deHaven-Smith (1991) concluded after an exhaustive study of environmental education provided to Florida residents:

Most people are preoccupied with their everyday lives---their work, homes, family and friends. For them, a philosophical orientation to the environment is unlikely. It is not that people are unconcerned about water and air pollution, energy

shortages, and the destruction of wildlife species, but rather that they relate to these problems in very narrow and concrete terms...Thus, the public's environmental concerns appear to be based not in an abstract ideology or philosophy, but rather in immediate experiences that are relatively concrete and close to home (p. 9).

His work tends to contradict the famous quote regarding environmental behavior which is attributed to Dubos (1980) "Think Globally...Act Locally" (p. 113). Hawken (1993) also agreed that most people do not think globally. American adults generally do not see any sense of urgency to dealing with environmental problems.

What misleads citizens in the richer nations is that we in the industrialized North are very well provided for indeed: with some notable exceptions, we either don't see, don't experience, or choose to ignore the impact our lives have. It is difficult for us to imagine that the ecological principle of carrying capacity can significantly affect us. Between the advertisements for Eddie Bauer Jeeps, the suburbs, and the mall, we assume that we're not taking too much from our environment, or we would see more signs of stress and deterioration around us (p. 203-204).

Sale (1993) pointed out that even those who consider themselves environmentalists tend to see the problems we face as "some isolated aberrations within a functioning ecosystem," rather than as "the inevitable byproducts of an economic system based on the imperative of growth and the exploitation of resources" (p. 100). Accordingly, the most radical environmental education efforts striving to inform the public and motivate adults to change their behavior,

have not been effective. Environmental education "has yet to discover a way to influence the complacent core of the American public except momentarily (p. 101).

Gigliotti (1990) concluded that this lack of action in responding to environmental education efforts was due to the fact that citizens have failed to make the connection between their personal actions and lifestyle and its impact on the environment. The same conclusion was reported by other environmental educators (Washington OPI, 1986).

He felt that "people have selectively screened the environmental education messages and constructed belief structures to support their own value systems rather than alter their lifestyles to any great degree" (p. 9).

A similar explanation had been proposed by Thompson & Gasteiger (1985) who conducted surveys of 3414 students and 3867 students at Cornell University in 1971 and 1981 respectively, in an effort to determine what items they would be willing to give up if they felt that the use of the item was causing harmful environmental effects. Despite the fact that the second survey was administered immediately after the first decade of the Environmental Movement, a period in which awareness levels of environmental issues greatly increased, the results were that students were more reluctant to give up items in 1981 than they were a decade before. The trend was toward a more materialistic lifestyle

(p. 22). The 1981 group also increased their support for promoting increased efficiency and conservation measures as possible solutions rather than sacrificing items they commonly used. He viewed this as an indication that the level of understanding regarding the impacts of the items about which the participants were questioned, also declined and that there was an increased tendency to believe that adopting conservation measures alone would be sufficient to solve environmental problems. This belief is unrealistic and cannot be supported by a factual analysis (Daly, 1980).

Pirages and Ehrlich (1974, p.43-44) asserted that much of the environmental damage could be blamed on our nation's commitment to a set of beliefs collectively referred to as society's "Dominant Social Paradigm" (DSP). They claimed that this set of values and beliefs had been accepted by the majority of the public since the end of World War II. They noted that the beliefs which had been cited most frequently are comprising the DSP are (a) Humans have a right to use natural resources, because they were created for human benefit; (b) The balance of nature will not be upset by human intervention; (c) The biological limits or carrying capacity of an environment can be overcome by the application of better technology; (d) It is necessary for our economy to continue growing to insure prosperity and progress; (e) It is wrong for the government to interfere

with private property rights by adopting environmental regulations; and (f) Technology can be depended on to solve any environmental problems that humans create.

They argued that the anti-ecological DSP is unrealistic and biologically impossible to achieve and would result in ecological disaster unless it was replaced by a more ecologically sound worldview. Dunlap and Van Liere (1978) reported evidence that such a change was occurring and that the DSP was slowly being replaced by a new set of beliefs which accepted the inevitability of biological limits to growth and recognized the need for a steady state economy that could exist in balance with nature. They named this emerging worldview the "New Environmental Paradigm" (NEP). They developed a 12 item survey, the NEP Scale, to test their hypothesis that a paradigm shift was indeed occurring. The items were designed to measure attitude toward the environment which they also referred to as concern for the environment.

The instrument was mailed to a random sample of 1441 Washington resident adults and a separate sample of Washington residents who were members of at least one environmental organization. They found that the NEP was strongly endorsed by the environmental organization sample and that "the general public tends to accept the content of the emerging environmental paradigm much more than we

expected" (p. 46). Their results indicated that the NEP scale was unidimensional and measured the broad construct of concern for the environment.

The NEP scale was further tested by numerous researchers. Albrecht, Bultena, Hoiberg, and Nowak (1982) surveyed samples of two populations, in Iowa in 1979 and 1980. After conducting factor analysis they found that the scale to provide a valid measure of the beliefs which comprise the NEP. However, they identified 3 constructs which were measured by the NEP scale. They labeled these as Factor One--Balance of Nature, Factor Two--Limits to Growth, and Factor Three--Man Over Nature.

Additional studies using the NEP scale by Geller and Lasley (1985), Pierce, Lovrich, Nicholas and Tsurutani (1987), Kuhn and Jackson (1989), Noe and Snow (1990), and Shetzer, Stackman and Moore (1991), also identified an increasing endorsement of the NEP attitudinal dimensions and thus, provided support for the conclusion that a paradigm shift was underway. Each of these studies also found that the same three factors emerged. However, Kuhn and Jackson (1989) after expanding the number of items in the scale used in their study, identified one additional factor which they labeled Factor Four--The Negative Consequences of Growth and Technology (p. 30).

Gigliotti (1994) followed up on the study at Cornell (Thompson and Gasteiger, 1985) by conducting a third survey of student's willingness to give up the same items which had been used in the 1971 and 1981 surveys. He also administered a modified NEP/DSP scale (Kuhn & Jackson, 1989) which he called the NEP growth and technology scale, to test the hypothesis that people who see the benefits of economic growth or have faith in technological solutions are less willing to make personal sacrifices. He found a significant relationship existed between the participants score on the NEP scale and their willingness-to-give-up score on 28 of the 35 items. Therefore, this provided evidence of a relationship between attitude, a person's concern for the environmental problems caused by growth and development, and behavior, making sacrifices for the good of the environment.

Gigliotti also found that the earlier trend toward materialism was continuing with fewer students believing that natural resources are limited. He emphasized the need for environmental education to help learners make the connection between the own lifestyles and increasing environmental degradation. Individuals must develop greater levels of TEAL especially regarding the impacts that they are causing when they use technology even though they cannot see the impacts. "Because of each individual's needs, desires, and actions, resource use and its' resulting

pollution occur whether it originates directly from the individual or from a factory that supplies the individual's needs and desires" (p.22).

Hawken (1993) discussed three major factors relevant to the findings of research and how these factors related to environmental problems. Hawken described one as "belief in technology" (Pirages and Ehrlich, 1974).

We are speeding up utilization of our resources through the use of fossil fuel servants, machines, and technology that allow us to get a lot more from our environment faster and more expediently than was formerly possible. This leads us to believe that technology in some form or another will provide the means to forestall or eliminate present and future threats posed by human exploitation of the environment (p. 205)

This conclusion was supported by a national poll (Roper, 1995) which found that 61% of the 1,000 American adults polled agreed that technology would find a way to solve all environmental problems. However, when questioned more closely, most did not have any idea how this will be accomplished, nor did they comprehend the biological and physical realities that effectively prohibit technological quick-fixes. Instead, they exhibited a blind faith belief that some type of miraculous breakthrough will occur before the problems we face become too severe.

Another factor cited by Hawken was "belief in economic development." Proponents of this view argue that we need a

"healthy growing economy" to pay for the changes that are required to "clean up the environment" (p. 205):

The health of the environment is subordinated to the health of an economy that by its nature depends on environmental exploitation. Unfortunately, in such an economy, financial incentives support technologies that give us the ability to harvest, extract, process, or mine our resources even more expeditiously (p. 206).

One final factor he cited was a lack of understanding by a large percentage of adults of the "limits of growth" (p. 206), or the limits of an ecosystem including Earth, to continually sustain population growth.

We in the rich industrial nations are under the impression that we are experiencing an ingenious outfoxing of carrying capacity. Clever, yes, but ingenious no, because our means of production do not necessarily increase the carrying capacity of the environment, they only temporarily insulate us from the result of our actions. We confuse our rate and ability to consume with the capacity of living systems to provide for those wants (p. 206).

A Call for TEAL Education

Numerous scholars who have studied the failure of traditional environmental education to facilitate the behavior changes needed to deal with the world's environmental problems, have stressed the importance of developing more effective educational programs that can succeed in meeting this vital goal. Hawken (1993) in a call to take action stated that:

Society must recognize that ecological principles apply absolutely to human survival, and that if we are to long endure as a world culture, or as a group of local cultures, we will have to incorporate ecological thinking into every aspect of our mores, patterns of living, and most particularly, our economic institutions (p. 202).

Devore (1984) felt strongly that adult technological literacy is essential if we are to survive. Technological systems must be based on stewardship in that they are compatible with nature rather than exploitive of it.

The challenge we face in creating a sustainable future will require new knowledge and understanding of social and technological systems, new values, and attitudes about our role as citizens and new skills, both technological and social. A large share of the tasks for creating and transmitting the new knowledge, understandings, values, attitudes and skills will be the responsibility of education (p. 10).

Schleicher (1989) agreed and pointed out that the situation "demands a fundamental change in human attitudes towards ourselves and nature." He urged efforts to develop "an ecological ethic of survival" (p. 277).

Orr (1992) argued that in order to achieve sustainability we must use ecology as the basis for the redesign of technology, since "In democratic societies wise public choices about environmental issues depend largely on the extent and breadth of public knowledge of ecology" (p. 136). The transition from our present system to one that is sustainable "requires people who know a great deal about such things as solar design, waste, composting, greenhouses,

intensive gardening, food preservation, and on site energy systems" (p. 137) In short, adults who have developed TEAL.

Ibikunle-Johnson(1989) explained that the efforts must not be limited to only public schools, but must reach the adult population as well. "In the long run, nothing significant will happen to reduce the local and international threats to the environment unless widespread public awareness is raised concerning the essential links between environmental quality and the continued satisfaction of human needs" (p. 13). Berberet (1989) concurred and added that one of our goals to nurture a sustainable society should be to "promote citizen education for sustainable development as a major goal of continuing education and life long learning programs in every community" (p. 6).

Two major organizations after carefully studying the issue, joined in calling for major changes in the way environmental education programs are conducted. The United Nations Educational, Scientific, and Cultural Organization (UNESCO,1988) explained:

Immediately, one recognizes that *nothing* is longer-term in this respect (i.e. the development and institutionalization of practices promoting sustainable development) than environmental education, conducted from preschool age children through the university years and all life thereafter, in school and out of school, *for all succeeding generations*. Problems and quality of the environment are not settled once and for all: they are a permanent concern and challenge (p. 1).

Finally, the World Commission on Environment and Development, also referred to as the Brundtland Commission, issued a report on their international investigation, Our Common Future (1987) which stressed their grave concerns:

Our message is directed towards people, whose well-being is the ultimate goal of all environment and development policies. If we do not succeed in putting our message of urgency through to today's parents and decision makers, we risk undermining our children's fundamental right to a healthy, life-enhancing environment...We call for a common endeavor and for new norms of behavior at all levels and in the interest of all. The change in attitudes, in social values, and in aspirations that we call for depend on vast campaigns of education, debate and public participation (p. 2).

Adult Environmental Education

Prazmowski (1990) agreed with the Brundtland Commission and said:

Their message is particularly relevant for adult educators. Adult educators can and must make the most of the opportunity, by building bridges between learners and the environmental and scientific communities, by designing programmes which help to inspire and empower. Adult educators can use educational courses as the starting point to examine the way our own institutions and facilities operate, and thus improve their environmental performance (p. 4).

Knowles (1980) also pointed out the need for institutional evaluation and change. "One of the missions of adult educators, then is to help institutions become increasingly effective as institutions" (p. 34). He also noted that organizations provide an environment for adult learning

which is then either facilitated or handicapped depending, on the structure of the organization and the methods it chooses. Only a democratic organization which facilitates decision-making using a collaborative, problem-solving process, and considers the needs and interests of the participants, is likely to enhance adult learning (p. 66).

Disinger (1991) also saw the potential for adult education methods to be applied to environmental education. "Opportunities and a need for environmental education for the adult general public are readily inferred" (p. 2). Field (1989) agreed that continuing education for adults regarding environmental issues was definitely going to be an important part of the future of adult education (p. 26). Disinger (1990) too, saw a need for adult educators to become involved since "it appears that educators generally favor the dominant social paradigm" (p. 5).

Imel (1990) added "adult educators possess a wealth of knowledge about adult learning and program planning and development that can be beneficial to environmentalists in carrying out their educational activities" (p. 2).

Camozzi (1990) also observed that:

The basic principles of adult education (needs assessment, self directed learning, and formative evaluation) are not commonly known. Too often, environmental educators stress the message rather than the medium by which it should be conveyed, and tend to rely on conventional pedagogical approaches inappropriate to adults (p. 199).

Several educators then, have seen the value of applying adult education methods toward making environmental education more effective. But just what role should adult educators play? Sutton (1989) felt that "Their role is to enable others to call for action and to make their own decisions. It is far more effective if wide sections of the population make political demands, to which the politicians will eventually listen" (p. 10). Programs should not try to dictate the outcomes too rigidly.

White and Senior (1994) declared that "self empowerment" would be effective for promoting behavior changes in adults and that the changes would have a ripple effect through the community (p. 215). This is consistent with the approach recommended by Horton (Conti and Fellenz, 1986) who advised that "Giving answers is not as good a way of education as asking questions and making people face up and think through things for themselves" (p. 12).

Knowles (1980) asserted that, perhaps the most important role of an adult educator is to serve as a "change agent" (p. 37). Adult educators can facilitate the learning needed to increase TEAL so that our socio-technological systems can be adapted to the realities of the 21st century.

Finger (1989) elaborated on the concept of assisting adult learners to develop higher levels of literacy:

Since learning is understood as a process which is closely linked to the total life of a person. I prefer to call it adult transformation as a total phenomenon including cognitive, emotional as well as action dimensions. In a field like environmental adult education, where commitment and action must be the ultimate aim of any educational practice, we must examine the total process of adult transformation. In fact, this is the only approach which is really meaningful for the adult learner (p. 27).

He further explained that adult environmental education should design learning experiences which are learner centered and will help increase motivation to change behavior as well as promote increases in knowledge. This process:

promotes an adult person who is not only concerned about the environment, but who ultimately acts, as a part of a collective movement, to protect it. If environmental adult education wants to make a significant contribution to learning our way out, it will, in my opinion, have to practice environmental adult transformation. Considering, the extremely serious situation of the environment today, environmental adult learning will never be enough (p. 30-33).

Gardner & Stern (1996) were especially critical of the failure of educators to study the problems in a manner which could provide answers to how adult environmental education could be made more effective. They lamented that many environmental scientists recognize that technology use by humans is the major cause of environmental harm but seldom do they study the human activities which are the root of the problem. And when searching for plausible solutions,

they often draw conclusions on intuition which are frequently mistaken. Models for changing human behavior are proposed "as if understanding human behavior does not require the same careful methods of study needed to understand ecosystems or climate" (p. 5). They described the problem as a lack of research into educational methods which might be more effective and certainly more appropriate than the guesswork approach which has prevailed in so many environmental education programs developed over the last two decades. What is needed according to the authors is "knowledge about human activities that alter the natural environment---which human activities are responsible, what causes their actions and how to change them" (p. 19).

Silver and DeFries (1990) supported this concept "So potent is the human impact on the earth system that knowledge of physical processes ruling terrestrial or atmospheric change will be incomplete until scientists better understand the human dimensions of that change" (p. 5). Developing a better understanding of adult attitudes and knowledge of the problems could lead to potential solutions, such as well-designed, effective adult environmental education programs.

Designing Adult Education For TEAL

Designing learning experiences for adults that can empower them to develop TEAL is a formidable task according to Kellner and Waupinski (1974) who recognized that "environmental literacy is no short course" (p. 27).

Newhouse (1990) reflected on the challenge and suggested:

How should conservationists who are interested in promoting environmentally responsible behavior design educational programs? First, the program must be appropriate for the level of knowledge, attitude and moral development of the individual...Learners should not be persuaded or manipulated: rather they should be given the skills to make future decisions for themselves (p. 32).

Consequently, it is important to assess both the knowledge and attitude of the target audience, and take into consideration the life experiences, feelings and values that the learner brings into the process. Iozzi (1992) noted that we should remind ourselves that environmental problems are not only technological problems, but they are social problems as well. "Therefore, environmental education must be dealt with holistically" (p. 70).

Dewey (1933) had realized much earlier that intellectual forces (cognitive domain) do not exist separated from attitudes, feelings and emotions (affective domain). This relationship shapes our behavior and causes us to be for example, either open-minded or close-minded, responsible or irresponsible (p. 28-33). Accordingly,

learning occurs at both levels and so both should be assessed in order to design learning experiences which can properly promote growth in both areas.

Iozzi (1989b) in considering the importance of dealing with both the affective and cognitive domains, explained that science can tell us what can be done, but society must decide for itself what shall be done. Thus, "environmental attitudes and value issues must be important and prominent aspects of educational programs" (p. 6). Morefoot & Blake (1978) agreed and suggested that it is essential to assess understanding which is affected by both knowledge and attitudes. A learner must grasp how a topic is related to other things he or she values if the new information is to be integrated into the cognitive or affective domain in a manner sufficient to influence behavior (p. 30).

Therefore, both knowledge and attitude are worthy of assessment. But how are they related? A common assumption of many environmental education programs has been that "if we make human beings more knowledgeable, they will in turn become more aware of the environment and it's problems and thus, be more motivated to act toward the environment in more responsible ways" (Hungerford and Volk, 1990, p. 9). However, the authors disputed this assumption. Although Zaltman & Duncan (1977) along with Hines, Hungerford and Tomera (1986) concluded that problem recognition was indeed

a first step in the information-seeking process which leads to making a decision to take action, Hungerford and Volk (1990) asserted that knowledge increases do not automatically lead to behavior changes. This supported the conclusions of Ramsey & Rickson (1976) who had conducted a study of 482 high school seniors to evaluate the relationship between knowledge and attitude relevant to environmental issues. They found that the relationship was significant but complex and not necessarily linear, meaning that increased knowledge did not always lead to unqualified support for pollution control programs. Later Iozzi (1989a) also noted that "merely increasing knowledge of the environment is insufficient for inducing positive affective growth" (p. 6).

But, Hines, Hungerford and Tomera (1986) did find that the relationship between knowledge and behavior was significantly positive in that "individuals with greater knowledge of environmental issues and/or knowledge of how to take action on those issues were more likely to have reported engaging in responsible environmental behaviors than those who did not possess this knowledge" (p. 3). They also found that there was a significant relationship between attitude and behavior. This was indicated by the fact that individuals with more positive environmental attitudes were

more likely to have reported that they engaged in responsible environmental behavior (p. 4).

Therefore, both attitude and knowledge are significantly related to behavior, but whether a relationship exists between knowledge and attitude is uncertain.

Gardner & Stern (1996) considered the relationship between attitude and knowledge and asserted that it is especially important to become aware of the learner's attitude which is basically determined by their values and beliefs. This is critical because people often react to environmental threats or problems based on beliefs when they have limited knowledge or experience in interpreting the significance of the threat. When an issue is raised the learner must decide whether to take it seriously and become concerned. This is usually done when they determine that the threat is posed toward something they value.

Therefore, attitude or concern for the environment may cause people to be more attentive to information about environmental threats and may cause them to take action to protect what they value. On the other hand, persons who accept the beliefs of the DSP may deny that human activities are harmful to the environment, because such a denial allows them to believe that they do not have to give up what they value. It might also be true that persons who have a strong

belief in the NEP, but limited knowledge might accept minimal evidence as proof that a technology is posing a threat to a natural system they care about.

The authors pointed out that "Values and basic ways of thinking about human-environment relations are hard to change in adults" (p. 67). As a result, it is especially important then, to assess them before and during an education program. Attitude and belief changes can only be accomplished by well-designed educational programs.

Furthermore, Gardner and Stern felt that assessing knowledge is also important because "many people, for instance do not know which of their daily actions are most responsible for energy use or toxic waste production" (p. 69). They speculated that these individuals may fail to take action because of this lack of knowledge, even when they have a pro-environmental attitude.

In conclusion they stated "Studies show that educational efforts to change environmental attitudes and beliefs generally have little effect on behavior" (p. 74). Likewise, programs that are designed to provide knowledge alone have been unsuccessful except in cases where the solutions are simple and low cost such as developing the habit of turning off a light switch when leaving a room. Therefore, the use of a variety of strategies should be incorporated into an adult education program designed to

increase TEAL, based on an assessment of the knowledge levels and attitudes of the target audience. It appears that educational programs designed without knowledge of these two factors are likely to continue to produce less than satisfactory results.

A final but important reason for conducting such an assessment was specified by Knowles (1980). He pointed out that "for the highest level of individual motivation to be achieved, it is imperative that the specific learning needs of the particular participants of a given learning activity be diagnosed---in fact, self-diagnosed" (p. 227). He further explained that the purpose of any self-diagnostic process should be to allow the learner to determine if there is a gap between their behavior and competencies in the subject area and an agreed upon model of desired behavior. He referred to the need for an adult learner to "get into a self-diagnostic frame of mind" as crucial (p. 229).

Furthermore, he believed that "if there is one thing that stands out about adult learning, it is that a self-diagnosed need for learning produces much greater motivation to learn than an externally diagnosed need" (p. 232). This provides a powerful argument for developing an instrument which can help a learner to realize that the impacts of technology use in their daily life are profound and that many of those technologies are under their direct control.

Knowles suggested that adult educators should find ways to help the learner become aware of the need for change. Educators are urged to use "a process that is more sensitizing than measuring, more concerned with setting broad directions of growth" (p. 230). Such a technique can "help individual adults look objectively at their present level of performance on a relatively small sample of behaviors that are important to them at a given time in their development and to determine where they want to invest energy in improving their performance in light of their models of desired behaviors" (p. 230). By giving learners this opportunity through the use of properly validated instruments, adult educators can set the stage to facilitate attitude changes as well as increases in knowledge.

Lastly, Houle (1972) described two complementary steps which should be taken to implement his "fundamental system" (p. 40) of designing educational programs. First he advised that the learning situation be analyzed to determine which method should be used as a framework for design. Second, a basic educational format should be applied and modified to fit the specific situation. The format he labeled "community education" seems most appropriate for promoting adult TEAL. Knowles (1980) predicted that refinements of this format would become a major development in the field of adult education "as a vehicle for community and self improvement"

(p. 150). Adult environmental education programs designed accordingly, may allow Knowles' prophesy to come true.

Chapter 3

METHODOLOGY

This study evaluated the relationship between two of the traits which are defined as prerequisites of Technological, Environmental, and Agricultural Literacy (TEAL). The traits which were measured are attitude toward the environment, and awareness of the detrimental environmental impacts which result from the use of technology. The study used the following procedures.

Population

One of the most popular housing options in Florida is a condominium or condo. There are presently more than 1 million condominium units in Florida, located in every county. Residents of all the condos in any one building are known collectively as a Community Association (CA). They typically form a legal partnership and select a board of directors to hire and supervise a CA manager. Smaller CAs often join together to share the expense of employing a professional manager. This study was conducted on a sample selected from all currently licensed Florida CA managers.

The Florida Department of Business and Professional Regulation (BPR), Division of Land Sales, Condominiums and Mobile Homes, is responsible for the certification and licensing of property managers including the managers of Community Associations. The duties of licensed CA managers usually include managing the condo's business affairs as well as the common areas located on the premises and held jointly by the owners. These normally include the grounds which often cover a substantial number of acres, one or more swimming pools, parking areas, club houses, and all stairs, halls and outsides of buildings.

Since the number of condominium managers licensed by the state changes constantly due to retirements, deaths, and licensure of new persons, the exact number of individuals in the population is unknown, but the total listed as currently licensed at the time this study was conducted was 8,266 persons.

Licensure requires the applicant to pass an examination covering a variety of topics about property management under Florida law. The majority of managers have received some form of training, either by private organizations who develop curricula for real estate professionals, or by serving as an apprentice manager. Continuing education units approved by the state, are required annually in order to maintain licensure. A large percentage of the population

have participated in educational programs which dealt at least in part with managing property in an environmentally benign manner.

Maintaining the appearance of the landscape on property they manage, as well as providing for the convenience and comfort of CA residents are normally high priorities in this profession. This usually requires consumption of high levels of energy and high volumes of water; disposal of high volumes of waste; and the frequent use of chemical fertilizers and pesticides. Therefore, CA managers were appropriate subjects for this study, because their position requires them to make decisions regarding technology use which affects the lifestyles of large numbers of persons. Their decisions can also have significant impacts on the local environment.

In many cases the clients to whom they are responsible possess considerable wealth, and may therefore be inclined to encourage the CA manager to adopt a management style which emphasizes a materialistic lifestyle rather than one which is highly concerned about environmental impact.

Research Design

Causal Comparative Research

The purpose of causal comparative research is to attempt to determine possible causes of behavior. This can

be accomplished by comparing persons who exhibit the behavior in question with persons who do not exhibit the behavior or who exhibit it to a smaller degree. This type of research is "sometimes treated as a type of descriptive research since it attempts to describe conditions which already exist" (Gay, 1987, p. 247). Causal comparative research is also known as ex post facto research (Latin - meaning after the fact), since the researcher is looking back after both the effect and its cause have already occurred in the persons being studied. In retrospect, the researcher then attempts to provide an explanation of the relationship between the effect or dependent variable, and its causes or independent variables. The purpose of this study was to compare the learner's awareness of the detrimental environmental effects of technology, to see if it tends to vary in the same manner as the other traits measured here, including attitude toward the environment. If such a relationship was established by the researcher, inferences could then be drawn regarding the predictive validity of the instrument used to measure attitude, a modified NEP/DSP scale, to also measure awareness of the harmful environmental impacts of technology.

Data Collection Procedure

Authorization and Survey

The researcher obtained authorization from the Director of the Florida Energy Extension Service at the University of Florida, Gainesville, Florida, to conduct the survey. The Florida Department of Business and Professional Regulation was contacted to obtain a listing of the currently licensed Community Association Managers. A sample was selected from this population randomly, except that in order to more accurately reflect the views of the population, the sample was stratified. The goal of this technique was to select a sample which was proportional to the subgroups of CA managers who were actively managing properties. The stratified sample was based on the percentage of CA managers who were actively managing properties in larger metropolitan settings as compared to those managing condominium units in rural, less heavily developed areas.

In other words, after it was determined that five percent of the total population was employed in the Miami area, five percent of the surveys were mailed to CA managers with Miami addresses using a table of random numbers to select individuals from this subgroup. Data from persons who were not actively managing property was eliminated, since the goal was to survey those who were actually making technological decisions rather than those who were licensed

merely for business management reasons such as disbursement of funds.

One thousand surveys were mailed to CA managers in July, 1995, along with a cover letter asking for their participation in the study and assuring their anonymity (see Appendix). The survey incorporated the TEAL survey, a modified version of the NEP/DSP scale and a request for demographic data regarding the respondents gender, age, years of experience as a professional real estate manager, and educational level.

TEAL Survey

The instrument developed for this study measured the participant's awareness of the detrimental environmental effects caused by the use of common technologies. The TEAL survey (see Appendix) which was mailed to the population sample contained 16 items which were designed to measure adult awareness of technology-caused environmental problems in four areas:

- 1) water consumption or pollution.
- 2) use of commercial fertilizer and pesticides.
- 3) waste generation and disposal.

4) release into the atmosphere of environmentally harmful gases such as carbon dioxide and sulfur dioxide due to the generation of electricity by burning coal or petroleum.

The survey produced a TEAL score for each participant which served as a measurement of that person's awareness level for the trait in question.

Format

The TEAL score was determined by responses to 16 statements on a five item Likert scale. For each statement the participant was asked to indicate whether they agreed strongly, agreed, were not certain, disagreed, or disagreed strongly. Since the TEAL survey was intended to measure awareness, participants were considered to have been aware of the specified problem only if they agreed with the statement for those items which were true (described a situation in which technology use does cause environmental damage). For statements which were false, the participant was considered to have been aware of the specified problem only if they disagreed with the statement. For all statements, the response "Not Certain" was considered to be an incorrect response since it indicated that the participant was not aware of the environmental damage caused by the technology in question.

Validity

Content validity is the degree to which an instrument accurately measures the intended content or subject matter area. It is composed of both item validity and sampling validity. Item validity refers to whether specific items represent measurement of the intended content. Sampling validity is determined by how well an instrument measures a broad spectrum of the entire content area. Gay (1987) explained that "content validity is determined by expert judgement. There is no formula by which it can be computed and there is no way to express it quantitatively" (p. 130).

Accordingly, content validity for the TEAL survey was established by the following procedure: (1) the researcher met with a panel of members of the University of Florida Energy Extension Service who were selected for their expertise in the content areas which the instrument measures. (2) Proposed statements were generated and distributed to each expert for review. (3) Revisions were made and reviewed until a consensus was reached by the panel that agreement or disagreement with each statement measures whether the respondent was aware of the harmful environmental impacts which result from the technology included in the statement. Only statements which measure awareness of accepted scientific phenomena were included.

(4) The TEAL survey was pilot tested by the researcher administering it in person to a group of CA managers participating in a continuing education course offered by the University of Florida Extension Service. The participants were encouraged to ask questions for clarification of points during the process of completing it. (5) Participants were encouraged to write comments about the questions and random interviews were conducted among the group afterward to determine whether the statements were clearly understood. (6) After additional modifications for clarification, the TEAL survey was printed for mailing.

Content validity was further established by computing the correlation between each individual item on the instrument with a respondent's overall TEAL score. By determining whether each item has a positive correlation with the individual's overall instrument score, this method provided additional support for the content validity of each item.

Construct validity is the extent to which an instrument measures a hypothetical or nonobservable trait known as a construct (Gay, 1987). Since a study by Ramsey and Rickson (1976) "supports the notion of a relationship between knowledge of and attitudes toward environmental issues" (p. 17), it is logical to conclude that a positive correlation between awareness (TEAL score) and attitude (NEP/DSP

score), would provide support for the construct validity of the newly developed instrument. Consequently, correlational analysis of these two variables was conducted yielding a product moment correlation of .17. This result suggests that the TEAL survey has construct validity.

Reliability

Reliability is the degree to which an instrument consistently measures the traits which it measures. Unlike content validity, there are quantitative methods available for measuring reliability. The most commonly used statistical technique for ordinal data is Cronbach's alpha. This technique provides a measure of an instrument's internal consistency. The range of Cronbach's alpha is from zero to one, with the higher value of alpha being an indication of greater reliability. An instrument with a Cronbach's alpha of .60 is to considered to be internally consistent and thus, reliable by some authorities (Mitchell & Jolley 1996). However, Gay (1987) specified that a minimum of .70 is needed in order for an instrument to be accepted as reliable.

The TEAL survey developed for this study was determined to have an alpha of .70 when all original 16 items were included. According to Gay (1987) this instrument should be considered marginal, so factor analysis was conducted to

determine if each of the items loaded onto meaningful factors and should be retained. This procedure determined that 14 of the items loaded onto six factors which accounted for 62.4 % of the scale variance. Two items failed to load onto any factor, while two other items loaded onto their own individual factors.

Therefore, additional factor models were evaluated and it was determined that in order to produce the most conceptually meaningful solution, a four factor model should be used which deleted the four items that either did not load or loaded onto their own factor. When these four items were deleted the instrument had an increased reliability coefficient of .76. Since one would expect an instrument with a higher number of items to have a higher reliability coefficient, the fact that alpha increased when items were deleted is further evidence that those items should not be considered in interpreting the results of this study. As a result, the findings of this study were based on a modified TEAL survey which was reduced to 12 items, and was determined to be a reliable instrument for the purpose of this study.

NEP Scale

The New Environmental Paradigm scale (NEP scale) was created by Dunlap and Van Liere (1978) to measure attitude

toward the environment. In the years following the beginning of the Environmental Movement, it was reported that America was undergoing a paradigm shift (Henderson, 1976) from a belief in the pursuit of materialism or the Dominant Social Paradigm (DSP), toward a more natural worldview which recognized limits to growth and the need to exist in harmony with nature or the New Environmental Paradigm (NEP). The NEP scale was designed to evaluate whether such a paradigm shift was actually occurring.

The original instrument contained 12 items that were developed in consultation with experts to establish content validity, and which attempted to measure the constructs of the NEP. It was tested on two Washington state population samples, 806 respondents from the general public and 407 respondents who were members of environmental organizations. The scale produced a Cronbach's alpha of .81 for the general public and .76 for the environmental organization members (Dunlap & Van Liere, 1978, p. 16). Factor analysis found that the 12 item scale was unidimensional. The authors argued that it's construct validity was further bolstered by significantly higher mean scores, showing greater environmental concern by the members of the environmental organizations than the general public.

The NEP Scale was further tested by Albrecht, Bultena, Hoiberg, and Nowak (1982). They surveyed samples of two

populations, and obtained responses from 468 urban dwellers and 441 farmers in Iowa in 1979 and 1980. Cronbach's alpha was .66 for the farm sample and .78 for the city residents. In attempting to establish construct validity for the instrument, they noted that "research has consistently shown farmers to be less environmentally aware and concerned than nonfarm populations" (p. 41). They concluded that since the mean score for urbanites was significantly higher than for farmers, their study supported the construct validity of the NEP scale.

However, after conducting factor analysis they found that the scale should be interpreted as measuring three constructs rather than one as was reported by its developers (p. 42). They also found that items consistently loaded onto the same three factors for both samples and thereby found the scale to provide a valid measure of the beliefs which comprise the NEP.

Geller and Lasley (1985) used the same data from the surveys conducted by Albrecht, Bultena, Hoiberg, and Nowak (1982), and data from another survey they conducted on Missouri farmers in 1980. They used confirmatory factor analysis to determine if the NEP scale possessed a stable factor structure. They were unable to verify that the full 12 item model was either unidimensional or measured three factors. But by reducing it to nine items, they found that a

model using the same three factors as the previous study, produced the best alternative for explaining their results. They concluded that the NEP was valid for measuring these same three dimensions that were reported by Albrecht, Bultena, Hoiberg, and Nowak (1982).

Another study using the NEP scale was reported by Pierce, Lovrich, Nicholas and Tsurutani (1987). They received completed surveys from 865 residents of Spokane and 1661 residents of Shizuoka, Japan. Their results indicated that even when the NEP was reduced to a six item instrument, it produced valid results in measuring the three constructs identified by earlier researchers.

Noe and Snow (1990) used the NEP scale to study visitors to three national parks. Eight hundred eighty surveys responses were gathered at Biscayne Bay National Park in Florida, 872 responses were obtained at Chattahoochee River National Recreation Area in Georgia, and 600 more were received from users of the Blue Ridge Parkway in Virginia and North Carolina. They calculated a mean Cronbach's alpha of .68 and agreed with Geller and Lasley (1985) that the scale was multidimensional and provided a valid measure of the constructs of the NEP. They concluded that the NEP scale "represents an advanced tool for measuring environmental concern" (p. 26).

Another study using the NEP scale was conducted by Shetzer, Stackman and Moore (1991), which also identified the same previously reported three factor solution with a Cronbach's alpha of .69, .62, and .75 for the three factors respectively. All of the factors loaded in an identical manner to that found by Albrecht, Bultena, Hoiberg, and Nowak (1982).

DSP Scale

The Dominant Social Paradigm scale (DSP scale) was developed by Dunlap and Van Liere (1984) to measure the constructs of attitude which comprise the DSP. This approach was used as a method of confirming the validity of the NEP scale which they had developed some six years before. By creating a scale which essentially measured the opposite beliefs of those contained in the NEP, they hoped to provide additional evidence confirming that the paradigm shift which had been reported by Henderson (1976) was in fact occurring. They also hoped to show that their previously developed instrument, the NEP scale, was an appropriate choice for measuring attitude toward the environment. The DSP scale consists of a 12 item Likert scale which measures the attitudinal dimensions of belief in technology, commitment to material abundance and prosperity, and belief in economic growth and private property rights.

The DSP scale was found to have a Cronbach's alpha of .78 and to effectively measure the same three factors contained in the NEP scale. However, it also identified a fourth significant factor which was labeled as belief in growth and technology (Dunlap & Van Liere, 1984).

NEP/DSP Scale

The NEP/DSP scale is an instrument which was created by Kuhn & Jackson (1989), by modifying and combining both the NEP scale and the DSP scale. Both of these 12 item scales had been previously judged to be valid instruments for measuring attitude toward the environment, so the authors conducted their study using statements from each. In 1984, their first survey produced 662 completed 24-item scales returned by residents of Calgary, and Edmonton, Alberta. Exploratory factor analysis was conducted and found a four factor solution with a Cronbach's alpha of .82. However, three statements did not load on these factors so they were deleted from the second survey. In 1986, they obtained 403 responses from the reduced instrument mailed to residents of the same two cities. Factor analysis again found that the same four factors emerged, with 20 of the 21 statements loading on the same factors as they had in 1984. Cronbach's alpha was .84. These studies helped to substantiate the reliability, validity and stability of factor measurement.

In each survey, the same eight statements loaded onto the one factor which was identified as the negative consequences of growth and technology (Kuhn & Jackson, 1989). These eight statements had a mean alpha of .79. They were combined with three other statements from the original NEP and DSP scales, which also appeared to deal with technology and limits to growth, to form the instrument used in another study by Gigliotti (1994). He referred to this shortened instrument as the modified NEP scale. He mailed it to 1,500 seniors at Cornell University, and by using three mailings, obtained the desired 70% return rate Gay (1987) cited for survey research. The results were that the modified NEP scale was found to have a Cronbach's alpha of .78. No factor analysis was reported, but based on the body of research reviewed by the researcher, both the NEP/DSP scale and the shorter, modified NEP scale appear to be reliable and valid instruments for measuring either three or four dimensions of attitude toward the environment.

A modified version of the NEP/DSP scale was used in this study to measure attitude toward the environment (see Appendix). The scale contained 14 statements, the 11 which were used by Gigliotti (1994) and an additional three selected from the NEP/DSP scale used by Kuhn & Jackson (1989). These statements were included because they appeared to focus on technology's impacts, one of the key areas of

interest in this study. Responses to each of the 14 items were gathered using a five item Likert scale which allowed the participants to state whether they agreed strongly, agreed, neither agreed nor disagreed, disagreed, or disagreed strongly with the statement.

Data Analysis

The demographic variables of age, gender, educational level and experience in managing real estate, were analyzed for frequency and percentage distributions to provide a profile of the population of licensed CA managers.

Distributions will also be determined for NEP/DSP scores, BIT scores, and TEAL scores to provide answers to the first three general research questions in Chapter One.

Content validity for both instruments used in this study was as recommended by Gay (1987), supported by expert judgement. In addition, correlation coefficients were determined for each individual item on the instrument compared to their overall instrument score. This method was used to establish that each item was measuring variance in the same direction as the complete instrument. Content validity is supported when no negative correlations are found.

This study used exploratory factor analysis to establish the construct validity of the TEAL survey. This

technique is "used to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables" (Norusis, 1988, p. B-41). Factor analysis provides evidence that an instrument is actually measuring the constructs it proposes to measure.

One basic assumption of factor analysis is that any large set of interrelated variables has common factors running through it which can be better explained and interpreted when reduced to a smaller number of reference variables. These reference variables represent the constructs measured by the data. Variables with high correlations are thus grouped to produce a more meaningful format for understanding which constructs have been identified by the instrument. Scores for variables which produce low correlations are considered less likely to share common factors (Norusis, 1988).

To determine the initial number of factors which provide the most meaningful interpretation of the data, eigenvalues were calculated using the factor analysis option in the SPSS Advanced Statistics program. The principal components method used by this program extracts factors by calculating eigenvalues which serve both as a criterion for selection and to measure the variance accounted for by that factor. In order to "minimize the number of factors that have high loadings on a factor" (Norusis, 1988, p. 55), the

varimax orthogonal rotation method was used. This helps to insure that loadings of the items in the instrument are compared in such a manner so that the final matrix produced allows for the most parsimonious interpretation of the data.

To further evaluate the factors selected, a scree plot of the factors was completed. The scree plot, so named because they tend to resemble the material which sloughs off and accumulates at the base of a steep slope, provides a graphic illustration of the point at which factors tend to break off and are no longer considered to be contributing any additional meaningful explanation of total variance. This provides visual evidence that the number of factors chosen is in fact, the most meaningful for that set of data.

Confirmatory factor analysis was also used to examine the construct validity of the NEP/DSP scale. This method allowed the researcher to measure whether the number of constructs or factors extracted from the data was comparable to that reported by previous researchers using this instrument.

One way analysis of variance was conducted using NEP/DSP scores and the demographic variables of age, gender, educational level, and years of experience to determine if significant relationships exist between these variables and TEAL scores. In those cases where the F ratio was found to be significant, and the degrees of freedom was equal to or

greater than two, post hoc comparisons were made to assist in confirming and interpreting the results.

Stepwise multiple regression was conducted to determine which variables should be retained in explaining their collective contribution toward total variation of awareness of the environmental impacts of technology in the sample within the selected confidence level.

Finally, cluster analysis was used to identify groups based on common characteristics which could not be seen by visual inspection. The key to cluster analysis is "its ability to examine the person in a holistic manner rather than as a set of unrelated variables" (Conti, 1996, p. 57). This multivariate technique was used to identify the number of homogeneous groups or clusters which provided the best solution for interpreting the data in order to provide an answer to research question number six.

Chapter 4

FINDINGS AND DATA ANALYSIS

This study evaluated the relationship between two of the traits which are defined as prerequisites of Technological, Environmental, and Agricultural Literacy (TEAL). The traits which were measured are attitude toward the environment and awareness of the detrimental environmental impacts which result from the use of technology. The study was conducted using two instruments, the TEAL survey and a modified NEP/DSP scale. Data was gathered from responses to a mailing of 1,000 packets to licensed Community Association (CA) Managers in the state of Florida. Twenty-eight packets were returned by the post office as undeliverable. Another 37 surveys were eliminated as unsuitable since they were returned by persons who were not actively managing real estate. This resulted in usable data from 396 CA managers for a return rate of 42.4%. This rate of return was less than the 70% recommended by Gay (1987) but was anticipated by the researcher, since the survey was conducted through the University of Florida Energy Extension Service. Reasons for not responding were expressed by some CA managers and included personal feelings

of animosity toward the University of Florida and skepticism that since the survey was related to the university, an ulterior motive involved might result in a failure to keep the opinions of the respondents confidential. These factors likely prevented some from participating in this study. Although this study was exploratory in nature, the results should be considered in relationship to the response rate

Description of Respondents

One of the purposes of this study was to provide descriptive information about the population of persons who manage Florida CAs, which are also frequently referred to as condominium developments. The participants in this study were generally highly educated, middle-aged professionals with a considerable amount of experience managing property. They ranged in age from 19 to 77 with the average age being 52. Fewer than one fourth reported that they had not attended college and only two did not complete high school. The mean educational level was 14.6 years with 43.9% reporting that they had completed four years of college, and seven reporting that they had earned doctorates. The average number of years of professional experience as a real estate manager was 11.5, with a maximum of 40 years. Fifty-nine percent of the respondents were males, 37% were females and 4% didn't report their gender.

The CAs that the respondents reported that they were currently managing consisted of an average of 325 units covering an average 45.9 acres. The largest development covered 935 acres of land, confirming that CA managers control technological decisions on properties which are of substantial size. A large majority of the respondents, 93.4% reported that they were responsible for supervising the maintenance of lawns, landscapes or golf courses. Almost all respondents revealed that they made decisions regarding the use of major energy consuming technologies, with 98.7% reporting that these included air conditioned common areas and 72.4% reporting that they managed a heated swimming pool.

Reliability and Validity of the Modified NEP/DSP Scale

Reliability

The measure of the internal consistency of an instrument is referred to as its reliability (Gay, 1987). One of the most commonly used statistics to measure the reliability of scales is Cronbach's alpha (Mitchell and Jolley, 1996). Cronbach's alpha or reliability coefficient ranges from zero to one with greater reliability indicated by higher values. An alpha of .60 is considered the minimum required to establish instrument reliability (Mitchell and Jolley, 1996). However, Gay (1987) felt that an alpha below

.70 was unacceptable. The modified 14 item NEP/DSP scale produced a Cronbach's alpha of .82. The seven items of the scale which had previously been identified as measuring a construct of major importance in this study, BIT, produced a Cronbach's alpha of .77. These results are consistent with the findings of Kuhn and Jackson (1989) who found an alpha for the 21 item NEP/DSP scale they used of .82, and an alpha of .78 for the eight items which they used to measure BIT. Though this study reduced their NEP/DSP scale from 21 items to 14 items and measured BIT using only seven of the eight items they used, the reliability coefficients are remarkably similar. Therefore, this study provides additional support that the instrument is reliable for measuring attitude including BIT in separate adult populations.

Construct Validity

Construct validity is the degree to which an instrument measures one or more dimensions of an hypothetical trait (Gay, 1987). Using factor analysis Kuhn and Jackson found that their modified 21 item NEP/DSP scale measured four constructs of attitude toward the environment. They identified these as Factor One--Negative Consequences of Growth and Technology, Factor Two--Relationship Between Man and Nature, Factor Three--Quality of Life, and Factor Four--Limits to the Biosphere.

The modified NEP/DSP scale which was used in this study consisted of 14 items. Since this modification was made on an instrument which had only been tested on two adult populations (Gigliotti, 1994; Kuhn and Jackson, 1989) it was necessary to reexamine the construct validity of the scale. The researcher conducted factor analysis to establish whether the reduced instrument measured the same factors as had been previously reported by Kuhn and Jackson (1989).

Factor analysis is a method which can "identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables" (Norusis, 1988, p. B-41). This procedure is designed to determine if a construct was measured by the responses on the instrument under examination. If the responses are in fact, measuring the construct, factor analysis will load them onto a common factor. In this case, the procedure extracted three factors from the data.

In Kuhn and Jackson's study (1989) items number one through number eight loaded onto Factor one. In the present study, seven of these eight items (see appendix) also loaded onto one factor. Only item number eight loaded in a different manner than found by Kuhn and Jackson (1989). For Factor Two, the previous study found that six items loaded. Only two of those items, number nine and ten were used in this study, but they also loaded onto one factor. In

addition one other item loaded onto that same factor. It was the only item, number 14, of those which had loaded onto Factor Four in Kuhn and Jackson's (1989) study, that was also used in the present study. Therefore, items nine, ten, and 14 loaded onto one factor in this study. Finally, three of the four items which were found to load onto Factor Three by Kuhn and Jackson (1989) were used by the present study. All three of these items, numbers 11, 12, and 13 loaded onto the same factor. They were joined by item number eight which switched from loading onto Factor One to Factor Three.

The results were that the loadings of the reduced instrument were almost identical to those found earlier, with the exceptions being that only items eight and 14 switched onto a different factor. To insure that the most parsimonious solution was identified, the identified factors were rotated. An orthogonal rotation was accomplished using the varimax method since it is able to minimize "the number of variables which have high loadings on a factor" (Norusis, 1988, B-54). All items had a loading of at least .43. The researcher was able to confirm a three factor model for the reduced NEP/DSP scale which measured three of the four constructs included in the original instrument (see Table 1). The factor which was not measured by the reduced NEP/DSP scale was identified by Kuhn and Jackson (1989) as Factor Four, Limits to the Biosphere.

Table 1. Varimax Rotated Factor Loadings of Items in the New Environmental Paradigm/Dominant Social Paradigm Scale

Item Number	Factor 1: Belief in Technology	Factor 2: Humans/ Nature	Factor 3: Quality of Life
3	.77	.15	.00
5	.69	.33	.00
2	.69	-.07	.32
4	.65	-.07	.28
6	.56	.30	.17
1	.47	.26	.21
7	.43	.40	.06
9	-.01	.73	.19
14	.16	.67	.26
10	.28	.61	-.20
11	.20	-.08	.70
8	.18	.10	.68
12	.08	.43	.60
13	.10	.43	.54

The researcher found that due to the fact that the loadings in this study were nearly identical to those found by Kuhn and Jackson (1989) the same three factors had been measured by the modified instrument, and that it was appropriate to retain similar names to those previously given these factors. Consequently, the factors measured by the modified NEP/DSP scale were Factor One--Belief in Growth and Technology, Factor Two--Relationship Between Humans and Nature, Factor Three--Quality of Life. These findings

support the construct validity of the modified 14 item NEP/DSP.

Content Validity

Gay (1987) noted that content validity was determined by expert judgement. It contains both item validity and sampling validity. Sampling validity refers to whether an instrument measures all of the concepts in the total content area. Factor analysis indicated that the modified NEP/DSP scale measured three constructs rather than the four measured by the NEP/DSP. Therefore, the sampling validity of the reduced instrument is less than the longer version. However, the conclusions reported by experts who tested it, (Kuhn and Jackson, 1989; and Gigliotti, 1994) support the notion that it has content validity. It measured fewer constructs but contained sufficient sampling validity for the specific purposes of this study.

To further establish item validity, correlation coefficients were calculated for each individual item and the total instrument score. This method provides support for content validity by revealing whether the variance measured by an item tends to vary in the same direction as the total instrument. No negative correlations would be expected in this procedure if all items have content validity. All correlation coefficients were positive and ranged from .33

to .55 (see Table 2). Therefore, this finding adds credibility to the assertion that the modified NEP/DSP has content validity for measuring environmental attitude.

Reliability and Validity
of the TEAL Survey

Reliability

The original TEAL survey developed for this study included 16 items. After responses from all items were analyzed, it was determined to have a Cronbach's alpha of .70. According to Gay (1987) this instrument should be considered marginal, so factor analysis was conducted to determine if each of the items loaded onto meaningful factors and should be retained. This procedure determined that 14 of the items loaded onto six factors which accounted for 62.4 % of the instrument variance. Two items, numbers 13 and 16 failed to load onto any factor, while two other items, numbers two and six loaded onto their own individual factors. The validity of any single item which purported to measure a separate construct on the basis of responses to that item alone would be highly suspect.

Table 2. Correlation Coefficients of Individual Items to the Total Score on the NEP/DSP Survey

Factor/ Item Number	Correlation Coefficient
Belief in Technology	
1	.47
2	.44
3	.50
4	.45
5	.55
6	.52
7	.43
Relationship between Humans and Nature	
9	.38
10	.33
14	.49
Quality of Life	
8	.42
11	.36
12	.48
13	.46

Therefore, additional factor models were evaluated and it was determined that in order to produce the most conceptually meaningful solution, a four factor model should be used which deleted the four items that either did not load or loaded onto their own factor. When these four items were deleted the instrument had an increased reliability coefficient of .76. Since one would expect an instrument with a higher number of items to have a higher reliability coefficient, the fact that alpha increased when items were

deleted was further evidence that those items should not have been used in interpreting the results of this study. Because reliability is critical for factor analysis to be meaningful, the TEAL survey was reduced to 12 items which was determined to be a reliable instrument for the purpose of this study.

Construct Validity

Factor analysis was conducted on the 12 items retained from the TEAL survey and it was determined that a four factor solution produced the most parsimonious explanation of the constructs measured by this set of data. This determination was made based initially on the four factors which had eigenvalues of 1.0 or greater. Additional models used three, five and six factors were also investigated and rejected. Further evaluation was made visually by producing a scree plot which confirmed that inclusion of more than four factors would not improve the interpretation of the constructs identified. Using the varimax rotation method, a matrix was produced which revealed that all items had loadings of at least .56 (see Table 3) onto the four factors extracted.

The major factor which was produced had an eigenvalue of 3.22 and included four items. These were numbers four, five, 14 and 15. Each of these statements dealt with

awareness of the harmful environmental impacts created by either the burning of coal or petroleum products such as liquified propane gas which is commonly used to heat swimming pools, or the consumption of electricity generated by the process of burning these fuels. The item which had the highest loading was number 14 which stated "Wasting energy wastes money but does not really harm the environment." The other three items measured awareness of the fact that energy consumption creates environmental costs as well as financial costs. As a result, the researcher labeled Factor One, Energy Literacy.

Factor Two included items number one, eight and 10. Both item number one and number 10 dealt with awareness of the water quality problems which can be created by the use of excessive amounts of synthetic fertilizers on landscapes especially in areas such as Florida with its high annual rainfall and sandy soils. Item number eight dealt with awareness of the high amounts of water consumption which can occur in areas with highly concentrated residential developments. Since each item which loaded onto this factor dealt with either water quality or water quantity, the researcher labeled this factor Water Literacy.

Table 3. Varimax Rotated Factor Loadings of Items in the Technological, Environmental, Agricultural Literacy Survey

Item Number	Factor 1: Energy Literacy	Factor 2: Water Literacy	Factor 3: Waste Literacy	Factor 4: Pesticide Literacy
14	.86	.18	.06	.05
15	.78	-.04	-.10	.17
5	.66	.07	.16	.07
4	.56	.30	.16	-.07
1	.11	.80	.25	.09
10	.09	.79	.22	.16
8	.11	.62	-.07	.05
3	-.00	.01	.77	.09
11	.04	.09	.73	.60
9	.23	.24	.60	-.08
7	.08	.06	.18	.87
12	.10	.18	.01	.87

Three items loaded onto the third factor. These were items number three, nine and 11. Both items three and 11 dealt with awareness of the environmental problems created by depositing such large volumes of solid waste into landfills. Item number nine referenced the water quality problems created by surface water runoff from parking lots and landscapes. Since all of the items dealt with problems created by disposal of solid waste and waste water, Factor Three was named Waste Literacy.

The final factor included items number seven and number 12. Both of these items specifically dealt with awareness of the environmental damage which can be created by the misuse or overuse of pesticides. Accordingly, Factor Four was labeled Pesticide Literacy.

Content Validity

During the development of the TEAL survey expert judgment was obtained in a series of consultations. The survey was determined by the panel of experts to be valid for measuring awareness of the harmful environmental impacts caused by certain technologies. In addition, an item to total score coefficient was calculated for each individual item in the survey. The results (see Table 4) revealed that all items had a positive correlation with the total TEAL score. Correlation coefficients ranged from .28 to .52. This indicates that each item was contributing to measuring the overall content area of this instrument, and provides additional evidence that the TEAL survey is valid for measuring the content for which it was designed.

Table 4. Correlation Coefficients of Individual Items to the Total Score on the TEAL Survey

Factor/ ITEM Number	Coefficient Correlation
Energy Literacy	
4	.40
5	.39
14	.52
15	.31
Water Literacy	
1	.52
8	.28
10	.51
Waste Literacy	
3	.29
9	.37
11	.36
Pesticide Literacy	
7	.39
12	.38

Research Question Findings

Research Question Number 1

What is the general attitude of professional real estate managers toward the environment?

The attitude of CA managers toward the environment was measured used a modified NEP/DSP scale which emphasized measuring the constructs which contitute their attitude regarding technological impacts. The scale ranges from a

minimum score of 14 to a maximum of 70. A score of 42 is considered to represent a neutral stance between beliefs which constitute the NEP and the beliefs of the DSP. Scores which are lower than 42 indicate a tendency to support the DSP while scores above 42 reveal an attitude that is supportive of the NEP. The greater distance an individual score deviates from the neutral point of 42, the more strongly that particular individual supports the constructs included in the worldview or paradigm represented by that end of the scale.

The participants in this study achieved a mean score of 47.1 with a standard deviation of 7.56. There were 73.7% of the individual scores which were above the neutral score of 42 with a maximum score of 68. This indicates that CA managers endorse the beliefs which constitute the NEP. However, CA managers tended to be relatively moderate rather than extreme in their support for the NEP with almost half, 43.9 % of all respondents scoring between 45 and 52. Only 51 respondents or 12.8%, had an average score of 4.0 for each item which yielded an overall score of 56 and indicated very strong support for the NEP.

Research Question Number 2

Do professional real estate managers support the concept that technology will be developed to solve all

environmental problems humans create before that damage becomes irreversible?

One of the attitudinal dimensions measured by the NEP/DSP scale was identified by Kuhn and Jackson (1989) as "negative consequences of growth and technology" (p. 29). This factor was also interpreted as a "belief in technology" (BIT), since individuals who reject the concept that growth and technology have negative environmental impacts see technology as only a beneficial force which will ultimately mitigate all environmental problems created by humans (Pirages and Ehrlich, 1974). Such individuals would be expected to receive a low score on those items in the NEP/DSP scale which measure this factor. The first seven items of the scale measure this construct. Accordingly, the lowest possible score, a seven would represent an extreme belief in the ability of technology to solve environmental problems, while a 35 represents a total rejection of this concept. A neutral score of 21 indicates that the individual neither accepts nor rejects this dimension of the NEP and DSP.

The respondents had an average score of 25.6. A total of 83.3% had a score higher than the neutral score of 21. As a result, the group overwhelmingly rejected BIT, the concept that technology could be counted on to solve any environmental problems which humans created. Since BIT was

cited by Dunlap and Van Liere (1978) as a major impediment in accepting the NEP, the responses to those items which measure BIT in this study reinforce the idea that CA managers tend to accept the beliefs of the NEP.

Research Question Number 3

What is the level of awareness by professional real estate managers of the detrimental environmental impacts caused by certain commonly used technologies?

The participant's awareness of the detrimental environmental impacts of technology as measured by the TEAL survey, varied widely. No one missed all 12 items, but 10 persons responded correctly to only one item, while another 26 obtained a perfect score of 12. The mean TEAL score was 7.5, which translates into 62.5% correct responses. Fully 1/3, or 33.8% of the CAs tested, missed six or more items for a percentage of correct answers of 50% or less. Only 42.5% got a score of 75% or higher, by answering nine or more items correctly. Distribution of the overall responses are listed in Table 5.

Based on the mean scores for those items which loaded onto each factor, the results were. Factor One--Energy Literacy; had an average 74.5% correct responses. Factor Two--Water Literacy; had an average 66.2% correct responses. Factor Three--Waste Literacy; had an average 53.4% correct

responses. Factor Four--Pesticide Literacy; had an average 49.2% correct responses. The item which was missed by more persons than any other, number 11, dealt with awareness that composting can significantly reduce the amount of solid waste going into landfills. Despite widespread educational campaigns in Florida addressing the need to reduce waste by recycling, only 39.9% responded correctly to this item. Therefore, the overall awareness level of community association managers is relatively low.

Research Question Number 4

Is there a relationship between awareness by professional real estate managers of the detrimental environmental impacts caused by technology and their attitude toward the environment including their belief in technology?

A Pearson product moment correlation was calculated for the respondents awareness and attitude using TEAL scores and NEP/DSP scores. The correlation coefficient was .17 indicating that attitude and awareness were not highly correlated. This indicates that other variables may be of greater significance in explaining the relationship between attitude and awareness.

Table 5. Frequencies of Responses on the TEAL Survey

Factor/ ITEM Number	Percentage Correct	Number Correct	Number Undecided	Number Wrong
Energy Literacy				
4	81.3%	322	57	17
5	79.5%	315	69	12
14	78.5%	311	77	11
15	58.8%	233	144	19
Water Literacy				
1	56.3%	223	136	37
8	83.1%	329	58	9
10	59.1%	234	115	47
Waste Literacy				
3	77.0%	305	81	10
9	43.2%	171	192	33
11	39.9%	158	202	36
Pesticide Literacy				
7	46.5%	184	144	68
12	51.8%	205	132	59

Research Question Number 5

Does awareness by professional real estate managers of the detrimental environmental impacts caused by technology interact with their attitude toward the environment and their personal traits of age, educational level, gender, and years of experience?

Stepwise multiple regression was used to evaluate the relationship between awareness of the detrimental environmental impacts caused by technology and attitude toward the environment as well as the demographic variables.

This method determined the order in which these variables were entered into the regression model to explain as much variance as possible and remain within the selected confidence level. An alpha of .05 was chosen for the regression equation in this case.

The first predictor variable entered was attitude toward the environment or NEP/DSP score. The R square was only .028. At step two, gender was entered into the equation increasing R square to .049. No other variables were found to significantly increase the R square. Therefore, the two significant predictor variables accounted for only 4.9% of the variation in TEAL scores. Although this amount is statistically significant, as a practical matter, the amount of variance which can be predicted by knowledge of attitude (NEP/DSP score) and gender is negligible.

Table 6. Stepwise Multiple Regression for Entry of Variables for TEAL Score.

Variable Entered*	<u>F</u>	R Square	Signif F	<u>P</u>
NEP/DSP score	11.35	.028	.0008	.01
Gender	10.10	.049	.0001	.05

*Only variables significant at .05 confidence level.

Research Question Number 6

Among professional real estate managers, can representative groups be identified based on their awareness of the detrimental environmental impacts caused by technology and their attitude toward the environment?

Cluster analysis was used to identify groups of CA managers within the sample who shared similar attitudes and levels of awareness. This multivariate quantitative procedure is able to extract hidden meaning within data that may appear to be unrelated. Using this powerful technique makes it possible to more fully recognize and explain relationships between variables than can be achieved by using less sophisticated statistical procedures such as correlations. Cluster analysis builds relatively homogenous groups or clusters of individuals by comparing all of the variables for each case and in doing so, considers the learner in a holistic manner to determine whether they share certain important common traits. This technique is particularly appropriate for supplementing standard quantitative procedures in an attempt to "tease sense out of the data" (Conti, 1996, p. 67). This method then is inductive rather than deductive, since it strives to "have meaning and understanding emanate from the data itself" (p. 67).

The cluster analysis method used in this study was Wards. This method was designed to create clusters which, after considering all of the variables of interest, are as much alike as possible and which are relatively similar in size. Ward's method is a preferred method in social science research.

The cluster analysis procedure was conducted using the four factors which were measured by the TEAL survey as well as the three factors in the NEP/DSP scale. These factors were One--Belief in Technology, Two--Relationship Between Humans and Nature, Three--Quality of life, Four--Energy Literacy, Five--Waste Literacy, Six--Water Literacy, Seven--Pesticide Literacy. In addition, the demographic variables for which data was gathered from the 396 participants in this study were also analyzed. Proposed solutions containing from two to seven clusters were examined. The three cluster solution was selected as the most meaningful for identifying the distinctive groups within the sample population. The three clusters were named based on their mean scores for the seven factors on which the clusters were based. The groups and the numbers contained were One--Complacents--82, or 20.7%, Two--Concerned--191, or 48.2%, and Three--Committed--123, or 31.1%.

Using the means of the the three groups for each of the seven factors examined, a one way analysis of variance was

calculated to determine whether there were significant differences between the groups. The results were that there were significant differences between groups for each factor except Pesticide Literacy.

The one way analyses conducted on the demographic variables found that none of the groups differed significantly on any of these variables. Therefore, age, education, experience and gender were not considered in naming and describing the three distinct groups revealed by cluster analysis.

Since significant differences were found among the groups for six of the seven measured factors of attitude and awareness, Tukey post hoc tests were conducted to identify which group means were significantly different from the others. Group means for each of the factors are provided in Table 8.

Table 7. ANOVA of Attitude and Awareness Factors Among Clusters

Factor	Name	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Belief in Technology						
Between Groups		2	6197.68	3098.84	692.50	.0001
Within Groups		393	1758.61	4.47		
Total		395	7956.30			
Humans/Nature						
Between Groups		2	369.86	184.93	50.29	.0001
Within Groups		393	1445.05	3.68		
Total		395	1814.91			
Quality of Life						
Between Groups		2	823.12	411.56	69.39	.0001
Within Groups		393	2330.77	5.93		
Total		395	3153.89			
Energy Literacy						
Between Groups		2	16.86	8.43	5.47	.0045
Within Groups		393	606.01	1.54		
Total		395	622.88			
Waste Literacy						
Between Groups		2	19.22	9.61	9.50	.0001
Within Groups		393	397.74	1.01		
Total		395	416.96			
Water Literacy						
Between Groups		2	20.91	10.46	9.45	.0001
Within Groups		393	435.00	1.11		
Total		395	455.91			
Pesticide Literacy						
Between Groups		2	1.33	.67	.82	.4423
Within Group		393	319.55	.81		
Total		395	320.88			

Therefore, three distinctive groups of CA managers were identified based on similarities in their attitude toward the environment and the level of their awareness of the detrimental environmental impacts of certain technologies.

Table 8. Cluster Means for Factors in the TEAL Survey and the NEP/DSP Scale

Factor Name	Cluster 1: Complacents	Cluster 2: Concerned	Cluster 3: Committed
TEAL Survey			
Energy Literacy	2.66	3.18	2.90
Water Literacy	1.61	1.97	2.26
Waste Literacy	1.30	1.53	1.90
Pesticide Literacy	.92	.96	1.07
Total TEAL Score	6.50	7.64	8.15
NEP/DSP Scale			
Belief in Technology*	19.74	25.24	30.85
Humans/Nature	9.50	10.58	12.15
Quality of Life	8.43	9.96	12.35
Total NEP/DSP Score	37.69	45.78	55.40

* Lower scores indicate a greater belief in technology.

Chapter 5

CONCLUSIONS and RECOMMENDATIONS

Summary of Study

Traditional environmental education programs have been trying to change behavior for more than two decades, but their success has been limited especially with adults. Programs have generally been geared toward increasing learner's knowledge in the hope that this would lead them to develop a more favorable attitude toward the environment. This approach is grounded in research which has shown that knowledge of environmental problems is a required prerequisite to action, and that attitude is also significantly related to environmentally responsible action (Hungerford and Volk, 1990). However, Gigliotti (1990) argued that the reason that most environmental education programs have failed is that they have been unable to help adults make the connection between their own lifestyle, especially their use of technology, and its impacts on the environment. He asserted that a favorable attitude was not necessarily related to a higher level of knowledge about the environment. Accordingly, this study measured both of these variables to determine whether there was a sound basis for making the assumptions on which so many environmental

education programs are founded, that increased awareness is significantly related to a proenvironmental attitude. To investigate the relationship between attitude and awareness it was necessary to measure both variables in the same population sample. Two instruments were selected to accomplish this task. The first was a modified NEP/DSP scale (Kuhn and Jackson, 1989) and the second was developed by the researcher for this study with the cooperation and assistance of experts at the University of Florida. A packet containing both instruments and a questionnaire to gather demographic data, was mailed to a sample of licensed Community Association (CA) managers in Florida and usable data was received from 396 adults. The data set was analyzed to provide answers to the research questions.

In addition, because the instruments used were newly created or newly modified, it was necessary to establish both their reliability and validity before any conclusions could be drawn regarding the data that they produced.

NEP/DSP Scale

The version of this instrument used in this study was created by adapting a 21 item scale that Kuhn and Jackson (1989) tested in a previous study. They found that it had a Cronbach's alpha of .84 and measured four dimensions of attitude toward the environment. Their study also supported

the results found by Dunlap and Van Liere (1984) who concluded that it had both content and construct validity.

In the present study the instrument was reduced to 14 items which were selected to measure environmental attitude generally, but with specific emphasis on the construct identified as belief in technology or BIT (Dunlap and Van Liere, 1978). The data produced a Cronbach's alpha of .82. Those seven items which were designed to measure belief in technology had an alpha of .77. Factor analysis confirmed that the reduced instrument measured three of the same four factors measured by the full NEP/DSP scale. These were identified as One--Belief in technology, Two--Relationship between humans and nature, and Three--Quality of life.

TEAL Survey

Reliability of the TEAL survey was measured by Cronbach's alpha and was found to be .76. Content validity was determined by series of in-depth interviews with a panel of experts. In addition, content validity was further supported by calculating item to total score correlations, all of which were positive.

Factor analysis was used to determine the construct validity of the instrument. The analysis revealed that the TEAL survey measured four dimensions of awareness of the detrimental environmental impacts of technology. These

factors were named One--Energy Literacy, Two--Water Literacy, Three--Waste Literacy, and Four--Pesticide Literacy. Factor Four had only two items which loaded onto it using the principle components method of factor analysis. Two items also failed to load onto any factor, while two other items loaded onto a factor of their own. This suggested that the original TEAL survey had weak sampling validity. Since inclusion of these four items reduced the reliability of the instrument they were not considered in the findings of the present study.

Additional data analysis was conducted to measure the extent of the relationship between attitude and awareness. A nonsignificant correlation coefficient of .17 was found. However, stepwise multiple regression was used to determine which variables best explained the variance. This process resulted in a meager 4.9% of the variation of awareness scores being explained, with the only two variables that were significant being first, attitude and second, gender.

Cluster Analysis

To develop a more meaningful interpretation of how the two main variables were related among groups of participants, cluster analysis was used. This technique helps to visualize structure within the data which may not be revealed by statistical techniques more commonly used by

the sciences. Cluster analysis revealed that there were three distinct groups within the sample based on shared characteristics among the seven factors which were measured by the two instruments. These groups were named One--Complacents, Two--Concerned, and Three--Committed. One way analyses of variance were run for each factor among the three groups to identify those factors which differed significantly. Additional Tukey post hoc tests were conducted to reveal which of the differences among groups were significant.

Differences Among Groups

The Tukey post hoc tests revealed that no two groups were significant different for the demographic variables of age, education, experience and gender. There were also no differences based on the factor Pesticide Literacy. Scores were universally low for all groups regarding awareness of the potential environmental impacts of pesticides used on landscapes and lawns. Since both statements which measured this factor dealt with awareness that the pesticides used by licensed landscapers are often the same as those used by farmers, it appears that the majority of licensed CA managers do not realize that lawn and garden pesticides can present an environmental threat.

Regarding each of the other six factors which constitute awareness and attitude, there were significant differences among the groups. All groups were significantly different from the other for each and every attitudinal factor. However, for those factors which are part of the construct of awareness, only Water Literacy was found to be significantly different for each group. For the other two factors, Energy and Waste Literacy, only the group which scored lowest was found to be significantly different from the highest group. In all cases, the differences between the highest and lowest group TEAL scores for that factor were significant.

Complacents

The group which had the lowest scores on all seven factors were labeled Complacents. In general this group, which contained about one-fifth of the sample was found to be both unconcerned about the environment and unaware that the technologies they use in their daily lives caused harm to the environment. They exhibited a moderate belief in technology with a mean score of 19.7 which was below the neutral point, a score of 21. They also had an average TEAL score of only 6.4 which was slightly better than getting 50% of the items correct.

Concerned

This group, which contained almost one-half of the sample, 48.2 %, tended to represent the middle ground between the other two groups. They had almost the exact mean score for TEAL, a 7.5 and an overall score for attitude, 46 that was skewed higher than the midpoint of 42. This group was distinguished as having a fair degree of concern for the environment but was still lacking in general awareness of technological impacts. The one unusual finding about this group was that they scored higher than group three on their awareness of the impacts of energy consumption on the environment. However, they were not significantly different from group three with regards to that factor.

Committed

The group with a significantly higher scores for both attitudinal factors as well as awareness factors was group three, the Committed. They differed significantly from the Complacents in every area except Energy Literacy. The overall NEP/DSP score for this group was 55.4, well above the median of 42. This indicated that the group, which contained almost one third of the respondents or 31.1%, was highly committed to protecting the environment. Their overall TEAL score, 8.1 was also higher than either of the other groups, which tends to illustrate that they are more

astute about the environmental impacts of technology. They also strongly rejected the concept of belief in technology with a BIT score of 30.8, which is almost 10 points above the neutral position of 21 for this trait. The Committeds have much greater concern for the environment and are better than either of the other groups at recognizing technological impacts, but still made an average TEAL score of only 67.5%.

Conclusions

Therefore, after considering the findings presented in this study the following conclusions are warranted.

The reduced NEP/DSP scale used in this study is a reliable and valid instrument. It is multidimensional in that it appears to measure three dimensions of attitude, (1) Belief in technology, (2) Relationship between humans and nature, and (3) Quality of life.

Likewise the TEAL survey is both reliable and valid for measuring four dimensions of awareness of the harmful environmental impacts of technology which are (1) Energy Literacy, (2) Water Literacy, (3) Waste Literacy, and (4) Pesticide Literacy. However, the TEAL survey is somewhat lacking in sampling validity.

The overall awareness level regarding environmental impacts of technology is relatively low among the population of CA managers surveyed in this study. The best variable for

predicting the awareness level of CA managers among those variables studied was attitude expressed as NEP/DSP score. However, this trait is highly complex and knowledge of attitude, and as well as demographic variables does not allow for prediction of more than a very small amount of the variance of TEAL.

The statistical relationship between attitude and awareness was extremely low with a correlation coefficient of only .17, however, a definite trend among groups was revealed by cluster analysis. This technique was able to uncover the fact that as attitude scores increased among CA managers, so did awareness levels consistently.

The overall attitude toward the environment of CA managers is one of concern as revealed by the average score on the NEP/DSP which was well above the neutral point. In fact, nearly 75% of the scores were higher than the scale median of 42. This indicates that on the whole, CA managers tend to accept the beliefs encompassed in the NEP. This further supports the trend found by others (Dunlap and Van Liere, 1978) of a paradigm shift toward the NEP.

Consequently, this study also supports a conclusion that belief in technology is declining. Among CA managers only the smallest group, the Complacents accepted this concept, and their acceptance was marginal since their mean score was relatively close to the neutral score of 21.

Implications and Recommendations

The finding that attitude and awareness are significantly related was not unexpected. However, the low correlation of .17 is somewhat deceptive. Initially, it seemed that attitude would not be a good predictor of awareness. This variable accounted for only 4.9% of the variance in awareness. However, upon further examination it was determined to be the best predictor of all the variables studied and though the relationship is significant it is also complex. This study provides support for the model proposed by Hines, Hungerford and Tomera (1986) which asserts that there is not a linear relationship between these two variables. That is, increases in knowledge do not automatically and directly lead to an favorable environmental attitude. Some 95.1% of the variance is influenced by other factors. The findings of this study indicate that these two variables are not sufficiently correlated to allow the use of either instrument alone to adequately assess the needs of learners. However, the implication in general, is that adult CA managers who tend to have a proenvironmental attitude also tend to be better able to recognize environmental risks posed by technology.

More importantly, there are distinct groups of individuals among the population of CA managers who share similar beliefs and knowledge components. By identifying the

group to which a learner belongs, an adult educator can design appropriate educational experiences accordingly.

For example, Gardner and Stern (1996) pointed out that one of the most helpful ways to break down adult's internal barriers to taking action to protect the environment is "to call attention to people's attitudes and beliefs that they already have, but that they may not connect to the situation they are in" (p. 87). If a CA manager has a proenvironmental attitude, an educator could design exercises which challenge them to apply their beliefs and raise their consciousness of the environmental impacts of their lifestyle.

For those who tend to believe in the DSP, an example exercise might challenge them to attempt to develop a realistic proposal to deal with the environmental impacts of overcrowding. This could serve to illustrate the futility of trying to conquer nature or exceed carrying capacity of a habitat. This process could successfully provide the learner with the opportunity to self diagnose their inadequate knowledge of technological impacts.

Consequently, the two instruments used in this study could serve as tools to motivate the adult learner and in so doing, improve the success of environmental education programs for adults. Therefore, it is recommended that the TEAL survey be modified to improve its sampling validity, by adding items which would increase the measurement of those

dimensions identified and to measure others not included in this study.

The TEAL survey should be appropriately modified and tested on additional populations to further determine its reliability as well. In addition, the findings of future studies would be enhanced by follow up focus group interviews conducted with members of each of the groups identified by cluster analysis. This qualitative procedure could provide additional insight regarding the relationship between attitude and awareness levels.

Additional research is needed to verify or dispute the finding of relatively low levels of TEAL discovered in this study. It is also advisable to conduct research on each of the identified groups regarding the effectiveness of educational programs designed to facilitate the self empowerment process advocated by recent adult environmental educators (Finger, 1989; White and Senior, 1994). Such research needs to focus on techniques which promote the ability of adults to recognize the impacts of their lifestyles and how these impact our environment.

Finally, additional research is required to develop a greater understanding of the numerous other variables which influence behavior along with attitude and awareness.

The researcher has a sincere desire to discover information which can lead to more effective methods for

adult environmental education, and has a commitment to assisting practitioners in applying improved techniques for facilitating adult learning regarding the environment. Therefore, it is recommended that institutional providers of adult continuing agricultural or technology education courses such as the CSREES, routinely conduct assessments of their target audiences and that they explore the techniques and approaches called for here. This will require the courage and the vision to change the content-based approach that has traditionally been used. However, the researcher is firmly convinced that the lack of success of previous methods, as well as the urgency of the need to increase adult TEAL, justify the call for experimenting with new methods.

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APPENDIX

CA Managers of Florida
 Address
 City, Florida XXXXX
 July 15, 1995

Dear Community Association Manager,

The University of Florida Energy Extension Service is starting a major new educational program which is designed to assist Florida Community Association Managers in finding ways to save both energy and money for the residents of the condominiums you manage. The focus of the new program will be to develop programs which will be approved by the Florida Department of Business and Professional Regulation (BPR) for continuing education credits to maintain your CAM license. Since this program is new, we would like to request your help in assessing how CA managers feel about energy and other environmental issues and to identify the topics of greatest need for related educational programs. Would you please take a few minutes to fill out the enclosed survey and return it in the pre-addressed postage paid envelope. THANK YOU for your help!

Community Association Manager's Survey

Age____ Gender____ Number of Years in Profession____

Did you graduate from High School_____?

Number of years you attended College?_____years. Degree earned_____

1. How many units do you supervise? 2. How many acres do these units occupy?
3. List the common areas you manage such as lawns, landscapes, golf courses, clubhouses?
4. Does the property have a pool? Is it heated? If so, by what?
5. Would you be interested in taking a correspondence course for CAM license recertification?
6. When you replace equipment do you calculate the lifetime cost of different choices available?

7. Do you usually select the option which provides the greatest energy savings?

8. Why or Why Not? Please elaborate.

Please check if you want to learn more about these subjects.

- | | |
|--|--|
| ☐ Air conditioning | ☐ Photovoltaic (solar) outdoor lights |
| ☐ Compact florescent lights | ☐ Programmable thermostats |
| ☐ Humidity control | ☐ Solar screens or shutters |
| ☐ Irrigation sensors/controllers | ☐ Enviroscaping |
| ☐ Solar water heating | ☐ Pool pumping and heating |
| ☐ Energy management systems (EMS) | ☐ Water Saving Devices |
| ☐ Other (specify) | |

9. Please list any suggestions or comments you have about the other topics for which you would like to see educational programs developed.

Please respond to EACH of the following statements by marking the one choice which most clearly describes how you feel about each statement. Please answer every question on **BOTH SIDES** of this paper.

	Agree Strongly	Agree	No Opinion	Disagree	Disagree Strongly
1. Science and technology often do as much harm as good.	_____	_____	_____	_____	_____
2. More emphasis should be placed on teaching children about nature than on teaching them about science and technology.	_____	_____	_____	_____	_____
3. When humans interfere with nature it often produces disastrous consequences.	_____	_____	_____	_____	_____
4. We cannot keep counting on science and technology to solve mankind's problems.	_____	_____	_____	_____	_____
5. Mankind is severely abusing the environment.	_____	_____	_____	_____	_____
6. Rapid economic growth often produces more problems than benefits.	_____	_____	_____	_____	_____
7. Americans are going to have to reduce their consumption of material goods over the next few years.	_____	_____	_____	_____	_____
8. In general, Americans would be better off if the nation's economy stopped growing.	_____	_____	_____	_____	_____
9. The positive benefits of economic growth far outweigh any consequences.	_____	_____	_____	_____	_____
10. Humans must live in harmony with nature in order to survive.	_____	_____	_____	_____	_____
11. We can continue to raise our standard of living through the application of science and technology.	_____	_____	_____	_____	_____
12. Economic growth improves the quality of life for all Americans.	_____	_____	_____	_____	_____
13. Most problems can be solved by applying more and better technology.	_____	_____	_____	_____	_____
14. There are limits to growth beyond which our industrialized society cannot expand.	_____	_____	_____	_____	_____

	Agree Strongly	Agree	Not Certain	Disagree	Disagree Strongly
1. Lawn fertilizer will not cause environmental harm, if the rate recommended on the bag is not exceeded.	_____	_____	_____	_____	_____
2. There is no need to study the environmental impacts before building a pipeline to carry water from north Florida to the southern portions of the state.	_____	_____	_____	_____	_____
3. As long as Florida had adequate landfill space the amount of trash generated is not really a problem.	_____	_____	_____	_____	_____
4. The benefits of using compact florescent lights are not enough to make it worth switching to them.	_____	_____	_____	_____	_____
5. Most home owners who replace their air conditioning system should get a larger unit.	_____	_____	_____	_____	_____
6. The average amount of hazardous waste discarded by each condo owner is about 8 pounds per year.	_____	_____	_____	_____	_____
7. Pesticides approved for use on landscape are always 100% safe for the environment.	_____	_____	_____	_____	_____
8. If every home in this county used low-flow showerheads and low-flush toilets, water use would drop significantly.	_____	_____	_____	_____	_____
9. Storm water runoff from lawns and parking lots is not a threat to water quality.	_____	_____	_____	_____	_____
10. With Florida's heavy rainfall and sandy soils, too much fertilizer is often applied to lawns.	_____	_____	_____	_____	_____
11. Composting is not a worthwhile method for reducing the amount of solid waste that goes into landfills,.	_____	_____	_____	_____	_____
12. Pesticides used by farmers are far more toxic than those used by licensed landscape professionals.	_____	_____	_____	_____	_____
13. Salt water intrusion into Florida's aquifers due to over pumping coastal wells is not a serious problem.	_____	_____	_____	_____	_____
14. Wasting energy wastes money but does not really harm the environment.	_____	_____	_____	_____	_____
15. The amount we pay for electricity is adequate to pay for all costs of producing it, including environmental costs.	_____	_____	_____	_____	_____
16. Septic tanks frequently harm water quality more than wastewater treatment plants.	_____	_____	_____	_____	_____

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