EFFECTS OF ENVIRONMENTAL EDUCATION ON SELF-CONCEPT AND ENVIRONMENTAL RESPONSIBILITY

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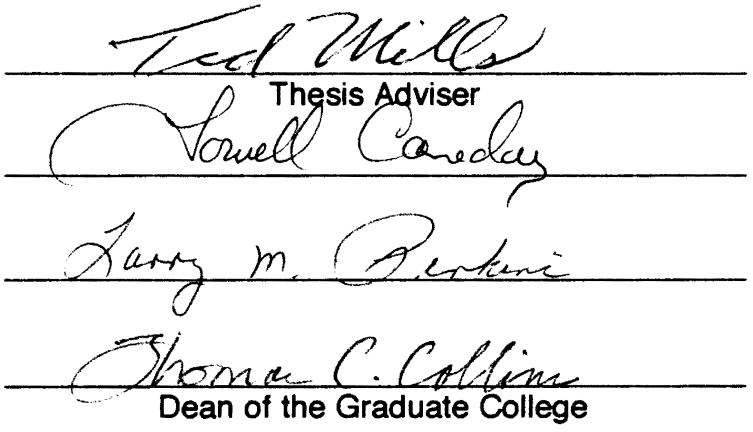

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TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I

THE PROBLEM

Introduction

American society is facing tremendous difficulties and uncertainties in dealing with a variety of problems surrounding our youth. Today, pregnancy and birth rates among unmarried teenagers are higher than they have ever been in the United States. More than half of the nation's seventh- to twelfth-graders drink alcohol and one in 15 teenagers report that they currently use both alcohol and illegal drugs, often leading to increased arrests for violent crime and property crime. Motor vehicle accidents are the leading cause of death among adolescents (often alcohol related), while homicide is second and suicide is third. For these and other reasons, it is not surprising that every school day 2,478 teenagers physically drop out of school and many more drop out mentally (Troy, 1991). The dilemma of educating and caring for this growing population of youth who have for whatever reason been unsuccessful in becoming socially responsible must be addressed.

In addition to these societal problems, social problems specifically relating to the environment abound. The Health of the Planet Survey conducted by Dunlap, Gallup, and Gallup (1992) involved interviewing representative samples of approximately 1000 citizens from each of 22 nations. When asked what the most important problems facing our nation today were, 11% of the United States sample responded "environmental problems, "as did 39% in the

Netherlands, Mexico (29%), India (21%), Japan (12%), Canada (9%), Russia (9%), Great Britain (3%), and 2% in Brazil. Four countries of the 22 survey samples believe air pollution and smog is the environmental issue of widest concern in the world. Another four countries believe pollution of rivers, lakes, and oceans is the most critical, while one country looks at loss of plant and animal species, and four are most concerned about loss of ozone in the earth's atmosphere. The environmental issue facing the world today that was most acknowledged as the issue of widest concern (nine of 22 countries sampled) was loss of rain forests and jungles.

A second poll, the Gallup Poll: Public Opinion 1990, indicated that two-thirds of Americans worry a great deal about environmental problems that could affect them directly, such as pollution of drinking water (65%), contamination of soil by toxic waste (63%), air pollution (58%), loss of natural habitats for wildlife (51%), and nuclear contamination (42%). Individuals also worry significantly about less direct effects: damage to ozone (43%), acid rain (34%), and the greenhouse effect (30%). In fact "A significant majority of Americans says that hardly anyone--the public itself (72%), the government (75%), or business and industry (85%)--is concerned enough about the environment" (Gallup, 1991, p.43).

Education has long been viewed as a major means of addressing societal problems and promoting social change. However, traditional education is failing to adequately address the needs of many adolescents. Adolescence is characterized by many physical and emotional changes. These changes may leave adolescents vulnerable to poor self-concept which they often demonstrate through negative, or socially inappropriate, behaviors. Also, many environmental issues are facing our world today, the responsibility for which will necessarily be assumed by young people. Experiential environmental

education holds much potential for facilitating positive changes in self-concept, and resulting behaviors, through opportunities for success in real life situations.

Significance of the Problem

Intuitively, and based on personal experiences and observations of others, we know what it is to experience both positive and negative self-concept. We also know that these feelings, positive or negative, affect the way we think and behave toward ourselves and our social and natural environments. The assumption, with some support from research, follows that a relationship must exist between self-perceptions and personally and socially responsible behavior. In fact, it has been suggested that "The lack of self-esteem is central to most personal and social ills plaguing our state and nation as we approach the end of the Twentieth Century" (California Department of Education, 1990, p. 78). If this is the case, investigation may provide insights into cost-effective strategies that can reduce the growing incidence of social problems and related personal and economic costs over the next generation.

Problem Statement

The guiding purpose of this study was to study the immediate and longer-term effects of a three-week residential environmental science academy on self-concept, and verbal commitment and actual commitment to improve environmental quality. It is hoped that the research will provide empirical data supporting assumptions that a residential environmental education program contributes to positive views of the self leading to personal, social, and environmental responsibility.

Research Objectives

The intent of this study is to determine: (1) if there is a change in self-concept for tenth through twelfth grade students attending a three-week long residential environmental science academy and for a similar group of participants attending a non-environmental academy (aerospace education) during the same period of time; (2) if students' sense of environmental responsibility is altered through participation in an academy (environmental science or aerospace education); and (3) if there is a correlation between self-concept and environmental responsibility for academy participants.

It is hypothesized that self-concept will change for participants of both the Environmental Science Academy and the Aerospace Academy. It is further hypothesized that environmentally responsible behaviors of participants in the Environmental Science Academy will be influenced. A positive correlation between self-concept and environmental responsibility is expected.

More specifically, the research objectives guiding this study are:

Research Objective #1: to determine if students who participate in the Environmental Science Academy exhibit a change in self-concept,

Research Objective #2: to determine if students who participate in the Aerospace Academy exhibit a change in self-concept,

Research Objective #3: to determine if students who participate in the Environmental Science Academy exhibit the same level of self-concept as students who participate in the Aerospace Academy,

Research Objective #4: to determine if students who participate in the Environmental Science Academy exhibit a change in environmental responsibility,

Research Objective #5: to determine if students who participate in the Aerospace Academy exhibit a change in environmental responsibility,

Research Objective #6: to determine if students who participate in the Environmental Science Academy exhibit the same level of environmental responsibility as students who participate in the Aerospace Academy,

Research Objective #7: to determine if a correlation exists between verbal commitment and actual commitment for environmental action, and

Research Objective #8: to determine if a correlation exists between environmental responsibility and self-concept.

Assumptions

Several assumptions were made regarding this research study; they are as follows: (1) participants responded honestly on all instruments, (2) differences between groups in times and locations for testing were not significant, (3) each dependent variable (self-concept, verbal commitment, and actual commitment) is normally distributed in the populations from which the samples are derived, and (4)each group and their respective population has the same variability.

Limitations

The nature of quasi-experimental research designs, particularly with repeated measures, creates a need to address limitations of the study. Following are the limitations of this study: (1) information is self-reported, (2) small sample size (n=25 for the experimental group, n=30 for the comparison group), (3) the samples are not random, (4) even though statistical procedures designed to compensate for repeated measures were utilized, repeated measures of the dependent variables with the same instruments may lead to pretest-treatment interaction, (5) subjects were not tested at the same time leading to time lapse and loss of subjects, and (6) history and maturation of participants may affect self-concept, a dependent variable.

Definitions of Terms

Aerospace Education Academy (Comparison Group): The 1992 Oklahoma State University High School Aerospace Education Academy served as a comparison group for this study. The aerospace academy is a multidisciplinary program that integrates science into aerospace. A detailed description may be found in Appendix B.

Environment: The biophysical, social, and psycho-physiological surroundings of an individual (Roth, 1991 May).

Environmental Responsibility: Incorporates an understanding of the impact of personal decisions upon society and our environment as a whole. Actions aimed at achieving an equilibrium between quality of life and quality of the environment. For purposes of this study environmental responsibility incorporates two components: verbal commitment and actual commitment. A high level of environmental responsibility is shown by high levels of commitment to improving environmental quality, as measured by the Verbal Commitment and Actual Commitment Subscales of the Ecology Scale (Maloney, Ward, & Braucht, 1975). Scores on the Verbal Commitment and Actual Commitment Subscales may range from one to ten, with ten being a high level of commitment. Also, a large number and variety of actions exhibited by participants as designated on the Environmental Knowledge and Personal Environmental Action Assessment is indicative of environmental responsibility (Ramsey, 1979).

Environmental Science Academy (Experimental Group): The 1992 Oklahoma State Regents for Higher Education High School Summer Academy for Environmental Science: Science, Technology, and Societal Interactions is

the model program for this research. The academy is multidisciplinary and experiential. A detailed description may be found in Appendix A.

Self-concept: The appreciation one has for one's own identity, worth, and importance and the character to be accountable for oneself and to act responsibly toward one's social and natural environment. A high score on the Tennessee Self-Concept Scale (TSCS) indicates a positive self-concept (Fitts, 1964). Normative data regarding the TSCS shows a score of approximately 330 is normal for adolescents (Roid & Fitts, 1989).

Organization of the Study

Positive self-concept is believed to lead to socially responsible behavior; this study is designed to determine if this commonly held belief may be supported empirically. As noted in Chapter I, the three areas of focus for this research are (1) change in self-concept, (2) change in environmental responsibility, and (3) correlation between self-concept and environmental responsibility. Chapter II contains a review of literature to more fully develop a relationship between the Environmental Science Academy, self-concept, and a sense of environmental responsibility; followed by a description of the experimental comparison groups, instrumentation, research design, and analysis in the third chapter. Results and discussion will be presented in Chapter IV and Chapter V will contain conclusions and recommendations. Detailed descriptions of the Environmental Science Academy and the Aerospace Education Academy, along with copies of the instruments used and anecdotal data, may be found in the Appendixes.

CHAPTER II

REVIEW OF SELECTED LITERATURE

Introduction

An extensive literature review was conducted between 1989 and 1993. Searches of the Educational Resources Information Center (ERIC), university library, and environmental education networks produced a variety of literature. A scarcity of literature specifically addressing a relationship between self-concept and environmental responsibility was evident. Prominent related categories identified were self-concept, environmental education, and predictors of environmental responsibility.

The scientific community, in its attempt to move from intuitive models of self-concept to the adoption of scientific procedures to establish relationships between variables, has experienced difficulties in quantitatively establishing associations between self-concept and its expected consequences. Possible reasons for mixed results in research are: the lack of a consensus on a definition for self-concept; multidimensionality of the construct leading to failure in measurement due to inappropriate instrumentation; many measurements assume self-concept to be constant -- a questionable assumption; small sample size; difficulty in measuring behavioral outcomes related to self-concept, self-concept could be expressed in a variety of behaviors -- not all measured; and inadequate control measures for age, income, ethnicity, intelligence, family structure, and other variables significant to development of self-concept and its

consequences (Beane, Lipka, & Ludewig, 1980; Marsh & Richards, 1987; Mecca, Smelser, & Vasconcellos, 1989).

Additionally, literature regarding the impact of environmental education experiences on the affective domain is sparse. General conclusions are tentative due to poor research design with inadequate control and randomizing procedures, lack of representative samples of adequate size, and inappropriate instrumentation (Crompton & Sellar, 1981). The following review of selected literature represents an attempt to synthesize the available literature into a comprehensive view of the relationship between self-concept and environmental responsibility.

The natural environment provides the basis for all life and is a major determinant of the quality of life experienced; yet, environmental problems often stem from our inability to develop social values, lifestyles, and institutions in harmony with nature (Swan, 1974; Maloney et al., 1975; Borden & Schettino, 1979; Cohen, 1991; Cortese, 1991). The belief that relationships between humans and their natural and manmade environments are tied to perceptions of their relationship with self is not new. In fact, Huber, Kyle, and Pizzini (1981, p. 37) reported one belief, "as the sense of personality deepens, the sense of environmental responsibility increases." Understanding the self is thought to be a precursor to understanding one's surroundings and ultimately to responsible behavior. Devall and Sessions (1985, p.14) state "we cannot ignore the personal arena nor the social, for our project is to enhance harmony with each other, the planet and ourselves" and propose that physical health cannot be separated from mental health, nor can individual health be separated from the health of the environment. The underlying premise of this relationship is the ecological interaction between humans and their environment in which no part may be totally separated from the whole. Devall and Sessions (1985, p. 194)

further suggest "an interplay between outward direct action and inward direct action, between acting on one's self and acting in the world."

The connection between humankind and our environment is perhaps best summarized by Wendell Berry (1977, p. 123), "it is impossible to care for each other more or differently than we care for the earth." Berry (1977, p. 124) continues, "There is an uncanny *resemblance* between our behavior toward each other and our behavior toward the earth.... By some connection that we do not recognize, the willingness to exploit one becomes the willingness to exploit the other." When addressing environmental education as a solution for revamping the United States education system to appropriately serve people for years to come, Roth (1988, p. 4) believes that environmental education should involve "not only gaining an understanding about the living system of nature but the fostering of strong positive self-concepts and a sense of community that allow people to act positively in a relationship with other people and the natural world." One curriculum, the Global Kidz ™ Club, is built upon the assumption that when people feel good about themselves they feel good about other people and their surroundings. A positive self-concept creates a sense of personal power enabling individuals to interact effectively with other people and new situations. "People who have positive self-esteem care about the earth and making a difference" (Wonders, 1990, p. 2). For this reason it has been suggested that the key to alleviating environmental problems lies in changing human behavior rather than in technological approaches (Culen, Hungerford, Tomera, Sivek, Harrington, & Squillo, 1986). It is generally agreed that the overriding goal of environmental education is to develop an environmentally literate citizenry that is both able and willing to act responsibly toward the environment (Swan, 1974; Tanner, 1981; Hungerford, Tomera, Volk, Sia, &

Hines, 1984; Sia, Hungerford, & Tomera, 1985/86; Roth, 1991 April; Charles, 1992).

Environmental literacy refers to "the capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems" (Roth, 1991 May, p.1). An environmentally literate person exhibits responsible environmental behavior with commitment and actions aimed at achieving an equilibrium between quality of life and quality of the environment (Hines & Hungerford, 1984). Responsible action is a conscious choice. Some actions are responsible, others are not (Charles, 1992). Responsible environmental action is the ultimate expression of ecological concern, yet an environmentally literate citizenry is not being developed as desired (Gray, Borden, & Weigel, 1985). If self-concept is a key to socially responsible behaviors and environmentally responsible actions are needed to alleviate environmental threats, perhaps strategies for enhancing self-concept will in turn promote environmental responsibility and a healthier environment.

Self-Concept

Educators and psychologists generally agree that positive self-concept and/or positive self-esteem are necessary for individuals because of the effect they have on levels of achievement, ability to adjust to the demands of their environment, and general state of well-being (Coopersmith, 1967; Luckner, 1987). In contrast, a consensus has not been reached regarding definitions of self-concept and self-esteem. Self-concept is believed by many to be multidimensional with many facets of the self, most of which are not directly observable, (Sharpley & Hattie, 1983; Gellen & Hoffman, 1984; Marsh, Richards, & Barnes, 1984; Tzeng, Maxey, Fortier, & Landis, 1985; Luckner,

1987; Marsh & Richards, 1987; Roid & Fitts, 1989). Perhaps this is the reason that both terms, self-concept and self-esteem, have commonly been equated and used interchangeably with self-respect, self-image, self-acceptance, self-worth, self-efficacy, self-confidence, and a variety of other terms. Generally speaking, the definitions of self-concept and self-esteem vary with the orientation of the researcher and research goals, yet self-concept and self-esteem are commonly believed to be similar and overlapping (Coopersmith, 1967; Beane et al., 1980; Martin & Coley, 1984; Mecca et al., 1989; California Department of Education, 1990).

Development of Self-Concept

Many theorists believe that as a child develops and has new experiences his self-perceptions evolve and change (Luckner, 1987). A person's perceptions of self are derived from one's experience and interpretation with one's environment in various social contexts throughout the course of life and are particularly reinforced by interaction with significant others. Self-perceptions are experienced internally, yet the perception is a product of interacting socially (Shavelson & Bolus, 1982; Myrick, 1987; Mecca et al., 1989). Richards (1976) proposes that from infancy onward, the human organism interacts with his/her environment and through this process builds up concepts of him/herself through interactions or experiences. These life experiences have values attached to them and are interpreted. Interpretation and perceptions of experiences may be confirmed by additional experiences, or they may go unchecked. Further, perceptions of what is meaningful to the individual are largely derived from the self-concept already in existence, in this way the self perpetuates itself -- a person may be limited by his or her self-

concept. Otherwise stated: our perceptions of reality, as constructed by our views of self, determine our reactions and behaviors.

Definition of Self-Concept

Recently there has been some agreement that self-concept incorporates self-esteem (Mecca et al., 1989). The term self-concept is commonly regarded as the definitional self; it is one's description or identity as a physical, social, and spiritual or moral being. Self-concept answers the questions "What am I like?" or "Who am I?" (Beane et al., 1980; Wright, 1982; Mecca et al., 1989). The portion of a person's self-perception answering the question "How do I feel about who I am?" is a person's self-esteem. Self-esteem refers to the level of satisfaction or worth an individual attaches to his or her self-description, the self-concept; it is the evaluative and affective aspect of self (Beane et al., 1980; Wright, 1982; Luckner, 1987; Mecca et al., 1989). Self-esteem is increasingly being divided into inner and outer components. Inner self-esteem corresponds to one's own feelings of efficacy, competency, and feelings of what effects one's actions have on one's social and natural environments. The approval or acceptance an individual perceives from significant others is the outer self-esteem (Mecca et al., 1989). For purposes of this study, self-esteem is treated as one component of self-concept. The definition of self-concept has been adapted from the California Task Force to Promote Self-Esteem and Personal and Social Responsibility. This task force was established in 1986 to compile research on the role of self-esteem as a possible causal factor in six areas of major social concern: crime and violence, alcohol and drug abuse, teenage pregnancy, child abuse, chronic welfare dependency, and academic failure. In addition, the task force was assigned to compile research on how healthy self-esteem is developed, damaged or lost, and revitalized, and to identify self-

esteem programs that people can turn to for help (Mecca et al., 1989; California Department of Education, 1990). Self-concept may be defined as the appreciation one has for one's own identity, worth, and importance and the character to be accountable for oneself and to act responsibly toward one's social and natural environment.

Self-Concept and Behavior

For years, theorists have suggested that the way one views oneself will influence one's decisions and actions. Therefore, a positive self-concept would bring about socially preferred behavior and a negative view of self would lead to socially inappropriate behavior. Individuals having an unrealistic self-concept would approach life and people in unrealistic ways (Tzeng et al., 1985; Roid & Fitts, 1989). Therefore, the feeling one has of oneself will be a prominent factor in the way one interacts with others and the behavior one exhibits. Henderson and Bialeschki (1984) believe that self-concept is the most important aspect of any human interaction and is a major determinant of every behavior. Self-concept influences one's level of achievement, behavior, ability to adjust to the demands of the environment, personality, and general state of well-being (Shavelson & Bolus, 1982; Sharpley & Hattie, 1983; Roid & Fitts, 1989). Individuals with high self-concept are more likely to be active in social groups and express their views frequently and effectively; they are happier and better able to meet everyday demands of their environment (Coopersmith, 1967). Self-concept appears to be correlated to locus of control (Mecca et al., 1989). Research conducted by Martin and Coley (1984) indicates that males and females having positive self-concepts have mostly internal orientation. Self-concept is not static, but rather continually changes and evolves as an

individual develops and has new experiences (Martin & Coley, 1984; Luckner, 1987).

Self-esteem is a primary factor in determining the well-being of an individual and how well or how poorly he or she functions in society. Citizens who appreciate themselves often have a strong sense of personal responsibility and are likely to attend to tasks necessary to maintain a healthy community and society. Therefore, the well-being of individual citizens is critical for the welfare of society. Persons having low self-perceptions often exhibit behaviors that become social problems (Mecca et al., 1989).

Social Problems

For a situation to be defined as a social problem, it must meet the following five criteria. (1) The situation or behavior must be identifiable by several people as a problem and must be unwanted. (2) Often it is a kind of behavior we consider to be contradictory to societal values or sacred beliefs and deviant as compared to some established law or norm. (3) Numbers of people exhibiting the behavior must be significant and on the rise. (4) A social problem involves economic and social costs. (5) Finally, it must be believed that we can effectively address the problem if we can identify and implement the right social policy and investment of resources (Mecca et al., 1989). Crime and violence, child abuse, alcohol and drug abuse, teenage pregnancy, academic failure, and chronic welfare dependency are commonly viewed as social problems. The complex of sexism-racism-ageism, physical and mental health, risks from nuclear power, and ecological and environmental threats have potentially been identified as social problems, as well (Mecca et al., 1989). Each of these situations creates enormous costs in human suffering and the expenditure of billions of tax dollars for intervention. If self-concept does indeed

have the profound effect on social responsibility, as it is proposed, perhaps strategies to facilitate development of positive self-concept could alleviate psychological, social, and financial burdens created by social problems.

Enhancing Self-Concept

Adolescence is particularly noted as a time when changes in self-concept take place, as young people change physically and are struggling to define their own identities and belief systems. These changes may leave adolescents vulnerable to confusion and foster development of poor self-concepts. Educators play a major role in students' views of themselves; therefore, it is essential that educators know ways to enhance views of the self.

Positive self-concept is nurtured by an affirming environment in the home, school, workplace, and community. This affirmation encompasses messages that convey the idea that the individual is the object of positive attitudes and possesses attributes and behaves in a manner which are positively valued by significant others (Mecca et al., 1989; California Department of Education, 1990). Self-concept develops gradually, is learned from experiences, and can change.

Viable strategies for enhancing self-concept suggested by Luckner (1987) follow: (1) Provide educational experiences that utilize cooperative learning procedures allowing students to identify similarities and differences from peers, and provide opportunities for peer tutoring and group discussion. (2) Teach students specific problem-solving skills and social interaction skills through modeling, guided practice, reinforcement and discussion; providing students with a sense of personal empowerment. (3) Expose students to other individuals' personal values, goals, and ideals; individuals that may serve as models. (4) Create situations that promote forms of disequilibrium within

students as motivation to learn and recognize what they know to resolve the disequilibrium. (5) Provide opportunities for success and accomplishment.

Experiential Learning. Experiential education of various types has often been successful in facilitating changes in participants' views of themselves in a positive direction. Orr (1992, p. 91) states that "real learning is participatory and experiential." Also, Kielsmeier (1989) suggests that we have many needs in our society that could be filled by youth through experiential service-learning creating meaningful roles to reinforce and provide opportunities for youth to apply new skills, values, and energy. The question arises then, what is experiential learning? Experiential education involves providing students with opportunities to be actively engaged in exploring ideas they find relevant and meaningful. Feelings, as well as thinking, are believed to lead to knowledge. The role of teachers is changed from giving information to facilitating students in learning from their world. Teachers must believe in students' abilities to make valid and meaningful conclusions from their own experiences (Chapman, 1992).

Walkabout models, named after a movie of the same name about the Aboriginal rite of passage for adolescents in the Australian outback, are experiential and aid students in becoming capable adults, i.e. confident persons who are willing to accept responsibility for their actions. One such program employs five "challenge environments" to allow students to apply their knowledge in real-life situations; the five environments are: applied academics, presentations, internships, community service, and wilderness (Knapp, 1989).

Outdoor education is also experiential. Outdoor education involves all the senses, while engaging the three domains of learning: cognitive (knowledge), psychomotor (skills), and affective (attitudes). Outdoor education

is a setting in which the whole person (physically, intellectually, emotionally, and spiritually) is involved in a learning process, possibly without being fully cognizant of the changes taking place (Miles, 1986/87). In addition, outdoor education, as a method of learning, is interdisciplinary in nature and may focus on relationships involving people and natural resources. It is a vehicle for creating an atmosphere in which one may analyze, and potentially change relationships (Priest, 1986). Relationships may be divided into four categories: intrapersonal, interpersonal, ecosystemic, and ekistic. Intrapersonal relationships are those within an individual, while interpersonal refers to those relationships between persons. The environment as a network of all things is the subject of ecosystemic relationships. Ekistic relationships are those in which people and their environment interact. In addition, Priest (1986) believes that outdoor education encompasses two basic themes: adventure education (emphasizing intra- and inter- personal relationships) and environmental education (emphasizing ecosystemic and ekistic relationships). Through the human aspect of outdoor education, one may increase personal growth, leadership, and communication skills (Whittaker, 1981; Ewert, 1986). The environmental perspective may aid one in developing and practicing responsible land stewardship ethics (Lutts, 1985). While emphasis may be placed on one theme, adventure education or environmental education, the two are inseparable and all four relationships will be affected by some degree (Priest, 1986).

For quite some time people have observed that adventure-based education tends to influence self-perceptions in a positive direction. One review of literature conducted by Crompton and Sellar (1981) shows that quantitative research supports these observations. Adventure-based education presents a perceived, and sometimes real, risk which can bring about change in self-

esteem through confrontation and mastery of fear. The risk involved may be more social than situational, a real-life situation for most adolescents (Kolb, 1988). Riggins (1986) has compared adventure-based programs with exemplary traditional classrooms and contends that each is effective when based on five shared characteristics: (1) creating a classroom culture that reflects positive, supportive values; (2) communication of high expectations for students; (3) building on student success; (4) small learning group size; and (5) cooperative learning environments.

Cooperative Learning. Cooperative learning methods involve grouping students into teams to work on a task outlined by the teacher. Each group must insure individual and team learning (Griffith, 1990; Slavin, 1990). The role of the teacher may change from disciplinarian and teller of truths to facilitator or manager with students finding and developing their own knowledge and learning through interactive methods (Lyman & Foyle, 1990). Research results have shown that students participating in cooperative learning techniques exhibited cooperation when appropriate; improved morale, role-taking ability, and interpersonal relations; enhanced self-esteem through increased opportunities to succeed and interact with peers; and improved academic achievement while avoiding school dropouts, both mentally and physically (Aronson, Bridgeman, and Geffner, 1978; California Department of Education, 1990; Lyman & Foyle, 1990; Slavin, 1990).

It is evident from the discussion of self-concept that while a consensus has not been reached on a single definition, most researchers and educators agree that a positive self-concept is central to individual and social responsibility. Since adolescence is a critical period in the development of an individuals' self-concept, it is an appropriate time to employ educational

techniques to facilitate positive growth. Opportunities for success, experiential learning, and cooperative grouping have been shown to be effective in enhancing self-concept. These techniques may be utilized in environmental education programs which emphasize ecosystemic and ekistic relationships, but as Priest (1986) suggests, may further develop interpersonal and intrapersonal relations as well. Following is a review of literature regarding environmental education and methods for promoting environmentally responsible behavior.

Environmental Responsibility

Education has traditionally addressed primarily cognitive skills. Recently, a shift has occurred emphasizing not only the cognitive domain (knowledge), but also the affective domain (attitudes, values, etc.) (Garrison & Stanwyck, 1979; Hungerford et al., 1984; Iozzi, 1989 Summer). This shift also involves a change from education as a teaching process to education as a learning process. Emphasis is now being placed on affective growth, including self-concept as a desired outcome in itself and as a variable influencing other relationships (Garrison & Stanwyck, 1979; Winne & Walsh, 1980). Additionally, it has been proposed that we address not only the natural environment, but also social, cultural, moral, and spiritual aspects (Caduto, 1985). In fact, Orr (1992, p.142) questions, "What about other traits, such as character, intuition, feeling, practical abilities, and instincts, which affect what people think about and how well they think?" It has been determined that the relationship between these factors is more complex than previously thought (Peyton & Miller, 1980). Roth (1991 April) proposes that environmental education programs focus on four basic issues: (1) the interrelationships between natural and social systems, (2) the unity of humankind with nature, (3) the impacts of technology and the

making of choices, and (4) developmental learning throughout the human life cycle. Further, environmental education should encompass techniques for observing and evaluating how people shape their natural and cultural surroundings, for better or worse. Experiential learning, investigation, values-clarification, and problem-solving strategies with the community as a resource should lead to the acquisition of knowledge, concern, desire, motivation, ability, and commitment to behave in an environmentally responsible manner and foster the development of an environmental ethic.

The United Nations Educational, Scientific and Cultural Organization (UNESCO, 1980) proposed that environmental education should ultimately build a sense of values and contribute to public well-being and survival of the human species. Additionally, UNESCO suggests that environmental education should be interdisciplinary, encompass all levels of education, in and out of school, and be directed to the general public. Environmental education is a lifelong, continuing process which responds to new situations. It should be centered on practical problems and promote initiative of learners and their involvement in environmentally responsible action. Specifically, the aims of environmental education should: (1) take into account actual economic, social, cultural, and ecological circumstances of the region; (2) enable people to understand the complex nature of the environment resulting from interaction of all its components and provide individuals with the means of interpreting this interdependence; (3) promote knowledge, attitudes, and skills needed for a high quality environment; and (4) foster responsible and effective behavior toward the environment. Knowledge should be acquired through observation, analysis, and practical experience in particular environments which may lead to favorable actions. This practical experience should prove to be meaningful and relevant to the students. Environmental education programs should also allow

discussion on the choice of solutions to environmental problems and the values supporting these choices. Skills needed to behave responsibly should be incorporated into environmental education programs; these include the ability to acquire, analyze, synthesize, communicate, apply, and evaluate existing knowledge (UNESCO, 1980).

Responsible environmental behavior is a learned response and is contingent upon several interacting variables (Sia et al., 1985/86; Hines, Hungerford, & Tomera, 1986). Variables influencing environmental action include cognitive, demographic, situational, and psycho-social variables. A review of these variables and techniques which may be utilized to promote environmentally responsible behavior follows.

Cognitive Variables

Certainly cognitive variables cannot be discredited; as the components - awareness, knowledge, skills, and action - are necessary. A person must first be aware of an issue and gain knowledge before he or she is able to act appropriately. However, awareness and knowledge alone are not enough to induce action. It is essential that skills for effective action be provided (Jordan, Hungerford, & Tomera, 1986). Also, some things can best be learned through action itself (McClaren, 1989).

Demographic Variables

Demographic variables potentially may affect environmentally responsible behaviors. Hines, Hungerford, and Tomera (1986) conducted a meta-analysis of research and found that: (1) there appears to be no relationship between gender and environmental action; (2) a weak relationship between age and environmental action was identified with younger individuals

being more likely to act; (3) persons who are more highly educated are slightly more likely to take action; and (4) a weak relationship between income and responsible action indicates that persons having higher incomes will act responsibly toward the environment more than those with lower incomes.

Situational Variables

Additional variables with potential to influence responsible environmental actions are situational factors. Economic and social constraints, and opportunities to choose between actions may alter behavior. Behavioral intervention strategies, such as incentives, appeals, information, and feedback may address these situational factors (Hines et al., 1986).

A "sense of place" may also influence actions an individual is likely to take. A sense of place is the concept of knowing where you are and where you come from (Orr, 1992). Individuals experiencing a sense of place often refer to "my environment" rather than "the environment"; our environment becomes personally significant to us. We are more likely to fight for something personally significant to us than for just a "thing" (Lutts, 1985).

Psycho-Social Variables

Attitude. Several psycho-social variables appear to influence environmentally responsible action; such variables include: attitude, economic orientation, personal responsibility, verbal commitment, and locus of control. The attitude construct is composed of three components: cognitive, affective, and conative. The cognitive component incorporates one's ideas, thoughts, knowledge, or understanding regarding an object (concrete or abstract). Commonly, a set of feelings or emotionality has been attached to this object and are viewed as the affective component of an attitude. The conative component

reflects behavioral tendencies associated with the attitude object. Generally, when a person speaks of an attitude, he/she is referring primarily to the emotional or affective component. In real life, however, the affective and cognitive components probably cannot be separated and therefore should be considered holistically in the teaching-learning process (Borden & Schettino, 1979; Gray et al., 1985; Iozzi, 1989 Spring). An individual's attitude about a topic will influence his/her actions. In fact, according to Hammond (1991), people generally choose to act from an emotional, rather than a purely rational, stimulus. Data and information are either constructed or transformed into their own belief systems and reinforce emotional stimuli leading to action and influencing the approach to action.

Economic Orientation. Economic orientation refers to an individual's cost consciousness and concern about the economic impact of certain environmental behaviors and environmental regulations. Although economic orientation influences behavior, Hines, Hungerford, and Tomera (1986) did not find a strong relationship between economic orientation and environmental responsibility.

Personal Responsibility. A positive correlation between personal responsibility and behavior has been identified. Individuals feeling some degree of responsibility toward the environment are more likely to act in a responsible fashion (Hines et al., 1986). Highly socially responsible persons tend to be free from preoccupation with self and have a strong sense of self-confidence and high self-demands and standards. Generally they have deep concerns about moral and ethical issues, a strong sense of justice, and a belief in the basic rightfulness of society. Responsible persons often exhibit social

initiative, cooperation, and independent thinking (Berkowitz & Lutterman, 1968; Gray et al., 1985).

Verbal Commitment. Verbal commitment is correlated to behavior, or actual commitment. An expressed intent to act is considered as verbal commitment, although it may actually be written rather than spoken. Intent to act often leads to action (Hines et al., 1986). It must be recognized that an inconsistency sometimes exists between intent to act and action itself (a person may intend to do something but not actually do it).

Locus of Control. Locus of control refers to one's perception of the degree of control one has over one's environment. If change is believed to be directed by chance or powerful others (God, parents, government, etc.), a person has an external locus of control. If one believes one can bring about change through one's own actions, one has an internal locus of control. The locus of control construct may be described as a distribution of individuals on a continuum of varying degrees to which they accept personal responsibility for what happens to them. Although locus of control is consistent over short periods of time, it may shift along the continuum with mental age (not chronological age). Included with locus of control is the "efficacy perception", or perceptions of effectiveness. If a person feels effective (internal locus of control), he or she will be more likely to take action (Peyton & Miller, 1980; Hines et al., 1986; Charles, 1992).

Peyton and Miller (1980) made several generalizations regarding locus of control with important implications for environmental education, such as (1) Individuals having an internal locus of control more frequently initiate and participate in productive action taking than externals. This is particularly relevant to the primary goal of environmental education of producing an

environmentally responsible citizenry that will take action. (2) Internals generally are better able to recall relevant information and more actively seek additional information than externals. Both of these characteristics are necessary qualities for making appropriate decisions. (3) Internal individuals are said to be superior to externals in their utilization of information, an essential component for accurate application of information in the decision-making process. (4) Internals are more resistant to subtle manipulation, are less influenced by high-prestige individuals, and are more discriminating in the influences they will accept than externals. Citizens must be rational and objective problem-solvers and not too susceptible to advertising. (5) Internal individuals exhibit a superior capacity to delay gratification in order to attain greater, long-term gains. (6) Internals respond differently to those tasks which they perceive to be skill-related than to tasks they perceive as chance-determined. Internals will pay less attention to tasks perceived as chance-determined, while externals will pay more attention. Yet, internals will participate more than externals if tasks are perceived as skill-related. This concept has definite implications for methods of presenting environmental issues. (7) An individual's perceived locus of control is susceptible to change in either direction, and is responsive to training.

Promoting Environmental Responsibility

Research indicates that if we want to promote personal significance of our environment and increase environmentally responsible action we must address the aforementioned variables influencing behavior. Following are several techniques believed to be beneficial in achieving the goal of an environmentally literate citizenry.

Environmental educators should create a classroom culture reflecting positive supportive values, communicate high expectations, and provide opportunities for success then build on that success (Riggins, 1986; Charles, 1992). Luckner (1987) indicates that physical activities are important because they allow one to recognize and understand his/her own strengths, weaknesses, and resources. Environmental educators should employ techniques for promoting internal locus of control, such as presenting the outcomes from environmental actions as skill-related and not due to chance, utilizing divergent questioning, and allowing adequate wait time (Peyton & Miller, 1986).

Values clarification activities may be employed to aid students in decision-making. Iozzi (1989 Spring) proposes that values clarification should be included in environmental education programs because most environmental issues are moral issues. Each day we face situations in which we must think, form an opinion, make a decision, and act on that decision. These decisions are based on our consciously or unconsciously held beliefs, attitudes, and values. Adolescents, in particular, may become confused on their values with the many sets of values they may be influenced by in their lives, i.e. parents, the church, teachers, peers, and the media.

Values clarification incorporates strategies to aid students in identifying or clarifying and acting on their values. A variety of approaches exist; one facilitates students in progressing through a seven step process in which one prizes and publicly affirms one's behavior, chooses freely from alternatives after considering consequences, then acts on the beliefs with consistency and repetition (Simon, Howe, & Kirschenbaum, 1972; Gray et al., 1985). Students thereby learn critical thinking and evaluation skills, and become effective in communication, knowing when to listen and when to speak (Wilson, 1983).

Hammond (1991) suggests that students must be exposed to a wide range of values and perspectives on an issue. It is important for students to be given freedom to choose because persons who realize they have the power of choice tend to be more self-respecting and responsible (Gray et al., 1985; Knapp, 1989). Empirical research and practical experience suggest that students exposed to this values clarification approach become less apathetic, less conforming and less over-dissenting; they may also become more energetic, improve in critical thinking, and be more likely to follow through on decisions (Simon et al., 1972).

Small class size, cooperative learning, positive adult and peer role models, peer tutoring, and experiential learning in and out of the classroom are critical for promoting environmental responsibility (Riggins, 1986; Luckner, 1987; Knapp, 1989; McClaren, 1989). Small groups are essential as they enhance group process skills, increase accessibility to the decision-making process and personal involvement, yet allow for diversity in personality and are still small enough to discourage formation of cliques (Monroe & Kaplan, 1980; Riggins, 1986; Luckner, 1987). Learning environments of this type often meet the needs of some learning styles not met by traditional methods (Knapp, 1989).

"Real-life" experiences are important to transfer knowledge and skills. These experiences may include case studies which aid in gaining familiarity with problems and solutions leading to a greater likelihood of environmental action, problem-solving strategies, communication and social interaction skills, guided practice, reinforcement, and discussion (Peyton & Miller, 1980; Monroe & Kaplan, 1980; Luckner, 1987). According to Knapp (1989, p. 30), "Dealing with the conflict and resolving the human problems will generally result in greater learning that lasts. We need to broaden our understanding of what is 'academic' and basic for meeting life's challenges." However, Knapp (1989)

indicates that experience is of limited value without adequate reflection upon it. Journal writing is a good way to record one's experiences and feelings, to look within and evaluate oneself, and engages the whole brain in processing the experience.

Several techniques have been suggested to promote environmentally responsible behavior; most of these strategies attempt to link learning to life. As stated by Orr (1992, p.183), "Students need opportunities to work together, to create, to take responsibility, and to lead in a community setting without which they are unlikely to comprehend the full meaning of virtue, ecology, or community."

Conclusions from research are that general knowledge of the environment and related issues, affective factors, and outdoor experience contribute to responsible action. Additionally, instruction regarding action must accompany education for awareness and knowledge (Hines & Hungerford, 1984). Techniques in environmental education should stress conceptual learning and affective learning, the formation of attitudes and values toward the environment, self, and others. Students must not only learn about, but experience, the interrelatedness of the natural world, for what one feels, one acts upon (Goodrich, 1981; Shaw & Mills, 1981).

Many educators have observed positive changes in self-concept in participants of environmental education programs. Self-concept influences the kinds of decisions and actions an individual will take. Generally, an individual with positive self-concept will exhibit positive behaviors. It seems evident that experiential environmental education holds much potential in facilitating change in self-concept and promoting environmental responsibility.

Strategies for Promoting Self-Concept and Environmental Responsibility

A review of strategies identified as having positive influences on self-concept and those shown to have positive effects on environmental responsibility indicate a significant number of techniques that influence both self-concept and environmental responsibility. Seven prominent educational methods have been shown to enhance both self-concept and environmental responsibility; they are: (1) an affirming learning environment, (2) opportunities for success, (3) values clarification exercises, (4) cooperative learning, (5) problem-solving techniques, (6) enhancing social interaction skills, and (7) experiential learning. Creating disequilibrium for students serves to motivate students to learn and resolve problems, thereby promoting positive self-concept. Additional techniques for building environmental responsibility are to increase knowledge and skills necessary to initiate responsible environmental action, along with sufficient reflection on the learning experience.

The Summer Academy for Environmental Science employs many of these educational strategies. Faculty, staff, and resource personnel for the academy actively seek opportunities to encourage participants in their pursuits of interest. Emphasis is placed on exposing students to information from many perspectives surrounding an issue; students must then analyze, synthesize, communicate, and apply this information, then evaluate the outcomes. This approach serves to create disequilibrium for participants as they are forced to create their own opinions from conflicting viewpoints. Simulation activities and role models are included in the curriculum to aid students in clarifying their personal values and resolving any existing disequilibrium. Cooperative learning techniques are employed primarily through the assignment of students

into research teams. Each research team is responsible for collecting and recording soil and water data, along with creating a slide show for chronicling the academy experience. Problem-solving and social interaction skills are constantly addressed through the gathering of information, personal and group evaluation of information, and communication among peers and resource persons. Journals are kept by academy participants as a method to aid in reflection of events, issues, and viewpoints. The academy, centered around major environmental issues and biomes of Oklahoma, is found by most participants to be relevant and meaningful in their lives. The Summer Academy for Environmental Science is experiential and attempts to link learning to life.

Summary

In summary, environmental and ecological threats may be deemed as a social problem. Social problems stem in part from a lack of personal and social responsibility due to poor self-concepts. Educational strategies for enhancing positive self-concept and promoting environmental responsibility were addressed. The aforementioned techniques have been shown to be effective in facilitating positive growth in both self-concept and environmental responsibility. The Summer Academy for Environmental Science is an environmental education program which incorporates many of these methods. The purpose of this study is to determine if a three-week residential environmental science program is effective in enhancing self-concept and environmental responsibility. Figure 2.1 diagrams the relationship between the Environmental Science Academy, self-concept, and environmental responsibility being investigated.

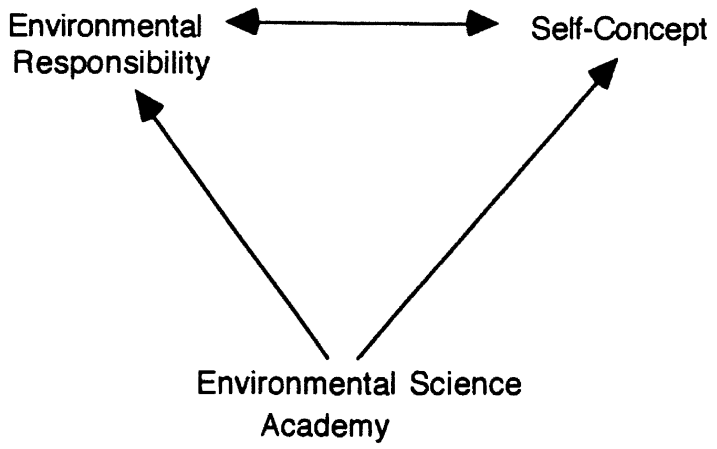

Figure 2.1. The Relationship Between the Environmental Science Academy, Self-Concept, and Environmental Responsibility Investigated in This Study.

CHAPTER III

METHODOLOGY

Introduction

The third chapter provides information pertinent to the methodology of the study. First is a description of the experimental and comparison groups. It should be noted that permission to involve human subjects in research was granted by the Oklahoma State University Institutional Review Board for Human Subjects Research prior to conducting the study. Participation in the study was voluntary and release forms were obtained from parents or guardians for individuals under eighteen years of age. Next is a detailed description of the instrumentation followed by an outline of the research design and procedures for investigation. A discussion of data analysis concludes the chapter.

Description of the Experimental Group

The Environmental Science Academy (EnvSci) is a multicultural, interdisciplinary, and experiential program (see Appendix A). The program format consists of seminars, discussion groups, laboratories, research teams, and field trips organized around the study of Oklahoma's major biomes and major environmental issues confronting Oklahoma, the United States, and the world. Stated goals of the academy are to: (1) raise awareness of major environmental issues, (2) increase knowledge about the ecological concepts that connect these issues, and (3) help participants identify opportunities they

have to address environmental issues now and in the future. The academy is an intense three-week residential program followed by an optional weekend reunion three months later. A community action component and completion of a home survey of energy, water, and other home use patterns are the only requirements for attending the reunion. The environmental science academy was evaluated to determine effectiveness in altering self-concept and environmental responsibility of participants; i.e. the experimental group.

Twenty-five high school juniors and seniors were selected from applicants across the state. Criteria for selection were: (1) academic potential as measured by an acceptable grade point average, (2) leadership potential, (3) student letter of application, and (4) documented member of an under-represented minority group.

Description of the Comparison Group

Participants in the Aerospace Education Academy (Aero) served as the comparison group in this study. Thirty students entering their junior and senior years in high school were selected based on academic progress, cultural identity, letters of reference, and statements of goals as related to the Aerospace Academy. The Aerospace Academy is a three-week residential program with the first two weeks devoted to curriculum in aerospace education and the third week providing field experiences (see Appendix B). Curricular activities include lecture and hands-on activities as well as computer experience. The objectives of the Aerospace Academy are to : (1) nurture the interest of students in biology, chemistry, physics, earth science and mathematics, and demonstrate how they can be integrated into aerospace education studies; (2) interest females and underrepresented minority groups in

the sciences; and (3) conduct an evaluation of the summer academy for future research purposes.

Instrumentation

Demographic Questionnaire

Demographic data were obtained to accurately describe the samples by age, grade, sex, academic background, rural or urban community, ethnicity, and environmental sensitivity. Students were identified by a code to assure anonymity. The demographic questionnaire is located in Appendix C.

Tennessee Self-Concept Scale

The Tennessee Self-Concept Scale (TSCS), developed by Roid and Fitts, consists of 100 self-descriptive statements. Sample copies of the TSCS may be obtained from Western Psychological Services of Los Angeles, California. This scale may be self-administered to individuals or groups and may be completed in 10-20 minutes. It is suitable for individuals 12 years or older with reading capabilities of at least the fourth grade level, and for individuals from a full range of psychological adjustment. The TSCS is available in two formats: the counseling form and the clinical and research form. The counseling form is made up of 14 basic scales and is intended for users who emphasize total score, and row and column scores; it is simpler in scoring, analysis, and interpretation and was used in this investigation. In contrast, the clinical and research form is clinically oriented with 29 empirical scales and is more complex in scoring, analysis, and interpretation (Roid & Fitts, 1989).

The TSCS is constructed in a three (internal frame of reference) X five (external frame of reference) X two (positively or negatively stated items) design. The internal frame of reference scales include identity, behavior, and self-satisfaction. Identity refers to the individual's private, internal self-concept, while the observable manifestations of self is one's behavior. Self-satisfaction is a measure of discrepancy between the actual self and the ideal self. Physical self, moral-ethical self, personal self, family self, and social self are the five subscales composing the external frame of reference. An individual's view of his body, health, sexuality, and appearance is the physical self. The moral-ethical subscale measures one's values and includes a bipolar religious component. Personal self measures one's sense of personal worth. The family self refers to one's feeling of adequacy as a family member, while the social self refers to a sense of adequacy and worth with respect to other people in general. The third component of the TSCS design is that one-half of the items are positively stated and the second one-half are negatively stated (Gellen & Hoffman, 1984; Marsh & Richards, 1987; Roid & Fitts, 1989).

Concern has been expressed by several theorists regarding internal structure of the Tennessee Self-Concept Scale and its use of norms with different samples. Independent research indicates that reliability between groups is high, yet inter-item correlations for subscales are low suggesting that the subscales overlap. Therefore, one should use either internal or external scales for interpretation. The external scales have been more readily supported than internal scales (Sharpley & Hattie, 1983; Gellen & Hoffman, 1984; Thomas, 1985; Tzeng et al., 1985; Marsh & Richards, 1987). Garrison and Stanwyck (1979) propose the TSCS is susceptible to "faking" (dissimulation) and "sleeping" (random response pattern). In response to these concerns, the 1989 version of the TSCS has included additional scales: the Stanwyck-Garrison

Faking Good Scale, the Seeman Personality Integration Index, the Number of Integrative Signs and Self-Actualization measure, and Psychological Harmony Scales (Roid & Fitts, 1989).

Norming data of the TSCS have been criticized for not adequately reflecting the United States' population. Heaps and Morrill (1979) and Sharpley and Hattie (1983) debate Roid's and Fitts' claim of relevance across culture and equivalency for both males and females. Since the original norms were established in 1956, new adolescent and adult norms have been added. Also, adaptations are recommended based on age, ethnic background, and socioeconomic status. Norms for the supplementary scales have also been established (Roid & Fitts, 1989).

Numerous independent samples measuring self-concept of adolescents have been combined in an effort to establish norms for adolescents. A composite mean score was calculated for all junior high samples and again for all high school samples. A normative sample was then selected to be representative of adolescents in the United States. These studies represent geographically and demographically diverse samples. A comparison of these samples resulted in a mean total score on the TSCS of 325.45, 320.63, and 334.14 for the junior high composite sample (n=1,339), the high school composite sample (n=318), and the selected normative sample (n=495), respectively. The composite junior high sample achieved a mean score of 36.31 on the Self-Criticism Scale of the TSCS, while the high school composite sample had a mean score of 37.53 and a mean score of 36.45 was calculated for the selected normative sample. Mean scores for the junior high, high school, and normative samples were 114.23, 110.42, and 116.34, respectively, on the Distribution Scale of the Tennessee Self-Concept Scale (Roid & Fitts, 1989).

Although accuracy of the Tennessee Self-Concept Scale has been debated, these problems have been addressed with updated information about norms, revision of the TSCS by incorporating new scales, improved instructions for handscoring, and new computer services. The TSCS continues to be the most popular self-concept scale and has been utilized in over 1,000 studies. The total score of the TSCS has been found to be a valid measure of global self-concept, while column scores or row scores may be utilized to measure multiple facets of the self-concept. Total scores on the TSCS correlate well with other measures of self-concept, for example the TSCS correlates with the Piers-Harris Children's Self-Concept Scale from .51 to .80 while correlation coefficients for comparison to the Cooper Smith range from .64 to .75. Researchers utilizing the TSCS report internal consistency as being .80 and above, with the total score being as high as .94. Test-retest reliability ranges from .60 to .92 and standard error of measurement varies with each scale, but ranges from three to six T-score points (Roid & Fitts, 1989).

The Tennessee Self-Concept Scale gives a fairly realistic profile of how a person perceives him- or herself and his or her own functioning if the individual has responded honestly, as measured by the self-criticism scale (Garrison & Stanwyck, 1979; Gellen & Hoffman, 1984). It is useful for a variety of purposes including counseling, clinical assessment and diagnosis, and research in behavioral sciences. For purposes of this study, measurement of total self-concept and change in self-concept were of primary interest; for this reason, for simplicity in scoring and interpretation, and due to indicated overlap of row and column scores, the counseling form of the Tennessee Self-Concept Scale was utilized. The total score on the TSCS, as a measure of self-concept, was analyzed for differences among and between the experimental and

comparison groups. Self-criticism and distribution scores were evaluated for validity of responses.

Ecology Scale

The Revised Ecology Scale (ES), written by Maloney and Ward, contains 45 items and is composed of four subscales, as shown in Appendix D. Affect and knowledge determine environmentally relevant behaviors an individual currently engages in, or will become involved with, in the near future. Behavioral variables are measured by the Verbal Commitment and Actual Commitment Subscales. The Knowledge Subscale measures specific factual knowledge and includes fifteen multiple choice items. The degree of emotion an individual attaches to related issues is measured by the ten true or false item affect subscale. The Verbal Commitment Subscale is futuristic /probabilistic and measures what a person says he or she is willing to do in regard to environmental issues and is made up of ten true or false items. The final true or false scale of ten items measures the actual commitment of an individual. Three Subscales: Affect, Verbal Commitment, and Actual Commitment contain equal numbers of positively and negatively stated items. In three different studies the Revised Ecology Scale was found to be easy to administer, reliable and valid, possess internal consistency, and was resistant to possible systematic response biases (Maloney & Ward, 1973; Maloney et al., 1975; Borden & Schettino, 1979). In the present study the Verbal Commitment and Actual Commitment Subscales were utilized to quantitatively identify significant differences in environmentally responsible commitment among the two groups.

Maloney, Ward, and Braucht (1975) measured verbal commitment and actual commitment utilizing the Revised Ecology Scale for three samples: Sierra Club members (n=31), a group of college students in lower division

psychology courses (n=56), and a non-college adult group having less than 13 years of formal education (n=40). Sierra Club members had a mean score of 8.68 (SD=1.72) on the Verbal Commitment Subscale and a mean score of 8.61 (SD=1.38) for Actual Commitment. Mean scores for verbal commitment were 6.37 (SD=2.48) and 5.02 (SD=2.75) for the college and non-college samples, respectively. The mean scores on the Actual Commitment Subscale were 3.61 (SD=2.58) for the college group and 1.97 (SD=2.22) for the non-college sample.

Another study employing the Revised Ecology Scale was conducted by Edwards and Iozzi (1983). The research involved in-service teachers for grades K-12 from all disciplines. Twenty-nine teachers participated in a four-week environmental education institute. Verbal and actual commitment were measured at the beginning of the institute (pretest), the conclusion of the institute (posttest), one year following the institute (posttest + one year) and two years after the institute. Mean scores on the Verbal Commitment Subscale were 7.55 (SD=2.02), 8.03 (SD=1.74), 7.83 (SD=1.70), and 7.73 (SD=1.30) as time progressed. The mean score for actual commitment was 5.72 (SD=2.45) at the pretest, 6.97 (SD=2.02) on the posttest, and continued to increase to 7.43 (SD=2.04) and 7.42 (SD=1.51) at one and two years later. The results indicate that verbal commitment increased through the institute, then leveled off one and two years later. Actual commitment continued to increase from pretest to one year after the institute, then remained stable for another year.

Environmental Knowledge and Personal Environmental Action Assessment

One portion of the Environmental Knowledge and Personal Environmental Action Assessment (Action Assessment) was administered to

discover actions each participant believed an individual can take to remedy environmental problems and to determine the number and types of environmentally responsible actions each participant had taken in the three months prior to completing the assessment (Ramsey, 1979). In the current study the Action Assessment (see Appendixes E and F) was employed at the pretest and delayed posttest for the experimental group in an effort to determine changes in actual environmental behavior.

Journals

Journals were written by participants throughout the Environmental Science Academy. Students recorded experiences during the academy, personal reactions to these experiences, and evaluated the activities observed in various settings. Additionally, twice during the academy, students were given time to be alone in a forest and write their impressions of the experience; most of these took the form of poetry. For this study, writings by participants were read by academy staff with the intent of identifying changes in self-concept and environmental responsibility as anecdotal evidence supporting data from the subjective instruments (see Appendix G).

Research Design

A quasi-experimental design was employed using a combination of a time-series design and a factorial design. Time-series designs involve repeated measures over a period of time both before and after the treatment. Repeated measures designs require fewer experimental units, proving to be more economical in time, expense, and effort. However, analysis must compensate for pre-test treatment effects that may occur (Ferguson, 1981; Norusis, 1985; Dunn & Clark, 1987; Fraenkel & Wallen, 1990). Factorial

designs allow one to investigate interactions between the treatment and one or more dependent variables. Two three-week residential high school summer academies served as the independent variables; the Environmental Science Academy was the experimental group, while the Aerospace Education Academy served as the comparison group. The dependent variables being investigated were (1) self-concept and (2) verbal commitment and (3) actual commitment, two components of environmental responsibility. Additionally, correlational research was conducted to investigate the relationship between self-concept and environmental responsibility. The correlation coefficients actually reflect the correlation between verbal commitment and actual commitment, verbal commitment and self-concept, and actual commitment and self-concept.

Data Collection

The experimental group (EnvSci) was administered a pretest the first day of the academy, a posttest the last day of the academy, and a delayed posttest at the time of the reunion (three months later). The delayed posttest was mailed to academy participants not attending the reunion and follow-up telephone requests were made to gain maximum response. The pretest included the Tennessee Self-Concept Scale (TSCS), Ecology Scale, Environmental Knowledge and Personal Environmental Action Assessment, and a Demographic Questionnaire. The posttest consisted of the TSCS, Ecology Scale, and journals from the academy. The TSCS, Ecology Scale, and the Action Assessment served as the delayed posttest.

The comparison group (Aero) was administered a pretest the first day of the academy and a posttest on the last day. The pretest included the TSCS, Ecology Scale, and the Demographic Questionnaire. The posttest consisted of

the TSCS and the Ecology Scale. All subjects were instructed that the instruments were administered as one portion of ongoing evaluation and research associated with the academy. Figure 3.1 illustrates the research protocol for the experimental and comparison groups.

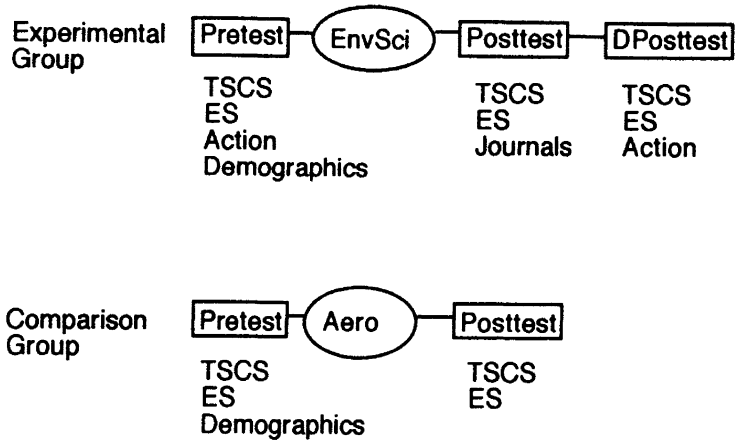

Figure 3.1. Diagram of the Research Format.

Data Analyses

To describe a set of data accurately measures of central tendency and variability are needed. The mean is the most stable measure of central tendency and therefore the sample mean was utilized in an attempt to find the best single value that was representative of each group's performance as a whole. Variability, the fluctuation of scores surrounding a measure of central tendency, was measured in the form of the standard deviation. Standard deviation is the most widely used measure of variability (Bartz, 1988). The

sample mean and standard deviation were calculated for each administration of the Tennessee Self-Concept Scale (total score), the Verbal Commitment Subscale of the Ecology Scale, and the Actual Commitment Subscale of the Ecology Scale.

Validity of responses on the Tennessee Self-Concept Scale was evaluated through scores on the Self-Criticism and Distribution Scales. Self-criticism scores between 27 and 49 are desired. Faking of responses, responding in a way that an individual believes is expected, is shown by scores below 27, while scores above 49 represent self-criticism at a high level and indicate a need for help. Scores below 85 on the Distribution Scale indicate guarded answers, clustered around neutral responses; while those above 170 suggest polarized or stereotyped responses, patterns of extremely high and/or extremely low responses.

Analysis of variance (ANOVA) is a statistical technique that allows two or more means to be compared to test for significant differences between or among the means (Bartz, 1988). ANOVA statistically analyzes the amount of variation in the scores between groups against the variation among members of the same group yielding an F value. This F value is compared to values in a statistical table for statistical significance. If the F value is sufficiently large such that differences are found indicating they are not likely to be due to sampling error, the null hypothesis is rejected (Iversen & Norpoth, 1976 ; Bartz, 1988; Fraenkel & Wallen, 1990). Two types of ANOVA were employed, both for repeated measures. Repeated measures designs involve measuring the individual on the dependent variable two or more times (Ferguson, 1981; Norusis, 1985; Dunn & Clark, 1987; Hinkle, Wiersma, & Jurs, 1988).

Repeated measurements will often be highly correlated since they are made on the same subjects; these correlations will reduce the error term. One-

factor repeated measurements involve measuring one variable for one group over a period of time. Two-factor analysis of variance evaluates two groups of subjects, each group undergoing a different treatment. Analysis of variance allows one to measure significant main effects and interaction effects. When an interaction effect occurs the interest in the main effect is diminished (Ferguson, 1981; Bartz, 1988; Hinkle et al., 1988).

Interactions may be shown graphically by plotting the group means with the dependent variable on the y-axis and one of the main variables on the x-axis. An interaction may be defined as a significant departure from a parallel relationship of two or more curves (Bartz, 1988). Therefore, if two lines are parallel, there is no interaction between them. If two lines intersect, an interaction exists. Group by test interactions between the experimental and comparison groups were plotted for self-concept, verbal commitment, and actual commitment.

One-factor analysis of variance for repeated measures was conducted for participants in the experimental group. Pretest, posttest, and delayed posttest scores were compared for the Tennessee Self-Concept Scale, and for the Verbal Commitment Subscale and the Actual Commitment Subscale of the Ecology Scale. Significance was tested at the .05 level of significance utilizing a two-tailed statistical table .

Scores for EnvSci participants were compared to those of Aero students with a two-factor analysis of variance for repeated measures. Comparisons were made for the Tennessee Self-Concept Scale, and for the Verbal Commitment Subscale and the Actual Commitment Subscale of the Ecology Scale. Again, significance was tested at the .05 significance level utilizing a two-tailed statistical table.

If significant differences are indicated by the F value resulting from analysis of variance, a Student's t-test may be employed. The t-test is used to determine which differences between means are significant and which are not. Independent t-tests are used for two independent samples, such as the experimental and comparison groups. In case of repeated measures for the same group, one should use a paired t-test (Bartz, 1988). When necessary, t-values were calculated then compared to a two-tailed statistical table to determine significance at the .05 probability level.

A correlation is the measure of relationship between two variables, often expressed as a correlation coefficient. Correlation coefficients may take any value between +1.00, a perfect positive correlation, and -1.00, a perfect negative correlation. The sign indicates if both variables increase and decrease together (positive) or if one increases as the other decreases (negative). The size of the coefficient indicates the strength or amount of relationship with 1.00 being a strong relationship and 0.00 (zero) indicating no relationship. The most popular and universal measure of correlation is the Pearson r which measures the amount of linear relationships between two distributions. After the correlation coefficient (r) is calculated, it may be compared to a statistical table to test for significance (Bartz, 1988). Correlations have been measured using the Pearson r method for each administration of the Verbal Commitment Subscale of the Ecology Scale, the Actual Commitment Subscale of the Ecology Scale, and the total score of the Tennessee Self-Concept Scale. Correlation coefficients were calculated between verbal commitment and actual commitment, verbal commitment and self-concept, and actual commitment and self-concept. Correlation coefficients were tested for significance against a two-tailed statistical table at the .05 probability level.

Participants of the Environmental Science Academy were asked to report actions they had taken aimed at promoting a healthy environment, during both the three months prior to attending the academy and the three months following the academy. The actions listed on the Environmental Knowledge and Personal Environmental Action Assessment were categorized into six groups: conservation and enhancement of resources, consumerism, recycling, communication and information, organizations, and clean-up projects. The types of actions placed into each category may be seen in Appendix F. Actions in each category were counted and represented as a column graph to determine if growth had occurred in both numbers of actions and breadth in the number of categories actions crossed. Data from this assessment was used as supporting evidence for measures from the Verbal Commitment and Actual Commitment subscales of the Ecology Scale. In addition, excerpts were taken from journals and poetry to identify if self-concept and environmental responsibility were enhanced through participation in the Environmental Science Academy (see Appendix G).

Research Objectives, Related Research Instruments, and Hypotheses

The research objectives of this study were developed following the review of literature and experience with the Environmental Science Academy in previous years. The objectives of this study were:

Research Objective #1:

To determine if students who participate in the Environmental Science Academy exhibit a change in self-concept.

Source of Data:

Mean total scores on the Tennessee Self-Concept Scale

Null Hypotheses:

$H_o{}^{1a}$: The posttest mean score of the Tennessee Self-Concept Scale is equal to the pretest mean score of the Tennessee Self-Concept Scale for Environmental Science Academy participants.

$H_o{}^{1b}$: The delayed posttest mean score of the Tennessee Self-Concept Scale is equal to the pretest mean score of the Tennessee Self-Concept Scale for Environmental Science Academy participants.

$H_o{}^{1c}$: The delayed posttest mean score of the Tennessee Self-Concept Scale is equal to the posttest mean score of the Tennessee Self-Concept Scale for Environmental Science Academy participants.

Method of Handling Data:

$H_o{}^{1a}$ through $H_o{}^{1c}$: One-factor analysis of variance for repeated measures

Research Objective #2:

To determine if students who participate in the Aerospace Academy exhibit a change in self-concept.

Source of Data:

Mean total scores on the Tennessee Self-Concept Scale

Null Hypothesis:

$H_o{}^{2}$: The posttest mean score of the Tennessee Self-Concept Scale is equal to the pretest mean score of the Tennessee Self-Concept Scale for Aerospace Academy participants.

Method of Handling Data:

$H_o{}^{2}$: Two-factor analysis of variance for repeated measures

Research Objective #3:

To determine if students who participate in the Environmental Science Academy exhibit the same level of self-concept as students who participate in the Aerospace Academy.

Source of Data:

Mean total scores on the Tennessee Self-Concept Scale

Null Hypotheses:

$H_o{}^{3a}$: The mean score of the Tennessee Self-Concept Scale on the pretest for participants in the Environmental Science Academy is equal to the mean score of the Tennessee Self-Concept Scale on the pretest for participants in the Aerospace Academy.

$H_o{}^{3b}$: The mean score of the Tennessee Self-Concept Scale on the posttest for participants in the Environmental Science Academy is equal to the mean score of the Tennessee Self-Concept Scale on the posttest for participants in the Aerospace Academy.

Method of Handling Data:

$H_o{}^{3a}$ and $H_o{}^{3b}$: Two-factor analysis of variance for repeated measures

Research Objective #4:

To determine if students who participate in the Environmental Science Academy exhibit a change in environmental responsibility.

Source of Data:

Mean scores for the Verbal Commitment and Actual Commitment Subscales of the Ecology Scale (Appendix D) and responses to the Environmental Knowledge and Personal Environmental Action Assessment (Appendix E)

Null Hypotheses:

$H_o{}^{4a}$: The posttest mean score of the Verbal Commitment Subscale of the Ecology Scale is equal to the pretest mean score of the Verbal Commitment Subscale of the Ecology Scale for Environmental Science Academy participants.

$H_o{}^{4b}$: The delayed posttest mean score of the Verbal Commitment Subscale of the Ecology Scale is equal to the posttest mean score of the Verbal Commitment Subscale of the Ecology Scale for Environmental Science Academy participants.

H_o^{4c}: The delayed posttest mean score of the Verbal Commitment Subscale of the Ecology Scale is equal to the pretest mean score of the Verbal Commitment Subscale of the Ecology Scale for Environmental Science Academy participants.

H_o^{4d}: The posttest mean score of the Actual Commitment Subscale of the Ecology Scale is equal to the pretest mean score of the Actual Commitment Subscale of the Ecology Scale for Environmental Science Academy participants.

H_o^{4e}: The delayed posttest mean score of the Actual Commitment Subscale of the Ecology Scale is equal to the posttest mean score of the Actual Commitment Subscale of the Ecology Scale for Environmental Science Academy participants.

H_o^{4f}: The delayed posttest mean score of the Actual Commitment Subscale of the Ecology Scale is equal to the pretest mean score of the Actual Commitment Subscale of the Ecology Scale for Environmental Science Academy participants.

H_o^{4g}: Participants in the Environmental Science Academy will exhibit the same number of environmentally responsible actions in the three months following the academy as during the three months prior to the academy as indicated by the Environmental Knowledge and Personal Environmental Action Assessment.

H_o^{4h}: Participants in the Environmental Science Academy will not exhibit a greater variety of environmentally responsible actions in the three months following the academy than during the three months prior to the academy as indicated by the Environmental Knowledge and Personal Environmental Action Assessment.

Method of Handling Data:

H_o^{4a} through H_o^{4f}: One-factor analysis of variance for repeated measures, Student's t-test

H_o^{4g} and H_o^{4h}: Categorization and tally of responses

<u>Research Objective #5:</u>

To determine if students who participate in the Aerospace Academy exhibit a change in environmental responsibility.

Source of Data:

Mean scores for the Verbal Commitment and Actual Commitment Subscales of the Ecology Scale (Appendix D)

Null Hypothesis:

H_o^{5a}: The posttest mean score of the Verbal Commitment Subscale of the Ecology Scale is equal to the pretest mean score of the Verbal Commitment Subscale of the Ecology Scale for Aerospace Academy participants.

H_o^{5b}: The posttest mean score of the Actual Commitment Subscale of the Ecology Scale is equal to the pretest mean score of the Actual Commitment Subscale of the Ecology Scale for Aerospace Academy participants.

Method of Handling Data:

H_o^{5a} and H_o^{5b}: Two-factor analysis of variance for repeated measures, Student's t-test

Research Objective #6:

To determine if students who participate in the Environmental Science Academy exhibit the same level of environmental responsibility as students who participate in the Aerospace Academy.

Source of Data:

Mean scores for the Verbal Commitment and Actual Commitment Subscales of the Ecology Scale (Appendix D)

Null Hypotheses:

H_o^{6a}: The mean score of the Verbal Commitment Subscale of the Ecology Scale on the pretest for participants in the Environmental Science Academy is equal to the mean score of the Verbal Commitment Subscale of the Ecology Scale on the pretest for participants in the Aerospace Academy.

H_o^{6b}: The mean score of the Verbal Commitment Subscale of the Ecology Scale on the posttest for participants in the Environmental Science Academy is equal to the mean score of the Verbal Commitment Subscale of the Ecology Scale on the posttest for participants in the Aerospace Academy.

H_0^{6c}: The mean score of the Actual Commitment Subscale of the Ecology Scale on the pretest for participants in the Environmental Science Academy is equal to the mean score of the Actual Commitment Subscale of the Ecology Scale on the pretest for participants in the Aerospace Academy.

H_0^{6d}: The mean score of the Actual Commitment Subscale of the Ecology Scale on the posttest for participants in the Environmental Science Academy is equal to the mean score of the Actual Commitment Subscale of the Ecology Scale on the posttest for participants in the Aerospace Academy.

Method of Handling Data:

H_0^{6a} through H_0^{6d}: Two-factor analysis of variance for repeated measures, Student's t-test

Research Objective #7:

To determine if a significant correlation exists between verbal commitment and actual commitment for environmental actions.

Source of Data:

Mean scores for the Verbal Commitment and Actual Commitment Subscales of the Ecology Scale (Appendix D)

Null Hypotheses:

H_0^{7a}: There is no significant relationship between pretest scores of the Verbal Commitment Subscale of the Ecology Scale and the Actual Commitment Subscale of the Ecology Scale for participants in the Environmental Science Academy.

H_0^{7b}: There is no significant relationship between posttest scores of the Verbal Commitment Subscale of the Ecology Scale and the Actual Commitment Subscale of the Ecology Scale for participants in the Environmental Science Academy.

H_0^{7c}: There is no significant relationship between delayed posttest scores of the Verbal Commitment Subscale of the Ecology Scale and the Actual Commitment Subscale of the Ecology Scale for participants in the Environmental Science Academy.

H_0^{7d}: There is no significant relationship between pretest scores of the Verbal Commitment Subscale of the Ecology Scale and the Actual Commitment Subscale of the Ecology Scale for participants in the Aerospace Academy.

H_0^{7e}: There is no significant relationship between posttest scores of the Verbal Commitment Subscale of the Ecology Scale and the Actual Commitment Subscale of the Ecology Scale for participants in the Aerospace Academy.

Method of Handling Data:

H_0^{7a} through H_0^{7e}: Pearson r correlation

Research Objective #8:

To determine if a significant correlation exists between environmental responsibility and self-concept.

Source of Data:

Mean scores from the Verbal Commitment and Actual Commitment Subscales of the Ecology Scale (Appendix D) and the mean total score of the Tennessee Self-Concept Scale

Null Hypotheses:

H_0^{8a}: There is no significant relationship between pretest scores of the Verbal Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Environmental Science Academy.

H_0^{8b}: There is no significant relationship between posttest scores of the Verbal Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Environmental Science Academy.

H_0^{8c}: There is no significant relationship between delayed posttest scores of the Verbal Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Environmental Science Academy.

H_0^{8d}: There is no significant relationship between pretest scores of the Verbal Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Aerospace Academy.

H_o^{8e}: There is no significant relationship between posttest scores of the Verbal Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Aerospace Academy.

H_o^{8f}: There is no significant relationship between pretest scores of the Actual Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Environmental Science Academy.

H_o^{8g}: There is no significant relationship between posttest scores of the Actual Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Environmental Science Academy.

H_o^{8h}: There is no significant relationship between delayed posttest scores of the Actual Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Environmental Science Academy.

H_o^{8i}: There is no significant relationship between pretest scores of the Actual Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Aerospace Academy.

H_o^{8j}: There is no significant relationship between posttest scores of the Actual Commitment Subscale of the Ecology Scale and the Tennessee Self-Concept Scale for participants in the Aerospace Academy.

Method of Handling Data:

H_o^{8a} through H_o^{8j}: Pearson r correlation

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The intent of this study was to determine: (1) if there was a change in self-concept for tenth through twelfth grade students attending a three week residential environmental science academy and for a similar group of participants attending a non-environmental academy (aerospace education) during the same period of time; (2) if students' sense of environmental responsibility was altered through participation in an academy; and (3) if there was a correlation between self-concept and environmental responsibility for academy participants.

Information was obtained to determine if differences exist between the experimental and comparison groups for selected demographic characteristics. Demographic information will be followed by results of the statistical analyses. The results presented here are organized around each of the specific research objectives and the relevant null hypothesis.

Results and Discussion

Demographic Data

Demographic data for the experimental (EnvSci) and comparison (Aero) groups shows essentially equivalent ratios in age, sex, approximate grade point

average, size of home community, and self-declared environmental sensitivity. Ages ranged from 14 to 17 years of age with most students being 16 years old (Figure 4.1). Approximately two-thirds of the participants were female in both groups (Figure 4.2) and students were primarily "A" and "B" students, academically (Figure 4.3). Many of the students were from small to mid-sized communities as shown in Figure 4.4. Environmental sensitivity was rated with one being low in sensitivity and ten being high. Participants for both groups were clustered in the region from five to eight in environmental sensitivity (Figure 4.5). The largest area of difference in demographic information between the two groups was in ethnicity (Figure 4.6). Participants in the EnvSci group (n=25) were primarily Caucasian (19), with a few Native Americans (3) and African Americans (3). In contrast, students in the Aero group (n=30) represented six ethnic groups: Native American (10), African American (3), Caucasian (9), Asian (5) Hispanic (2), and other (1).

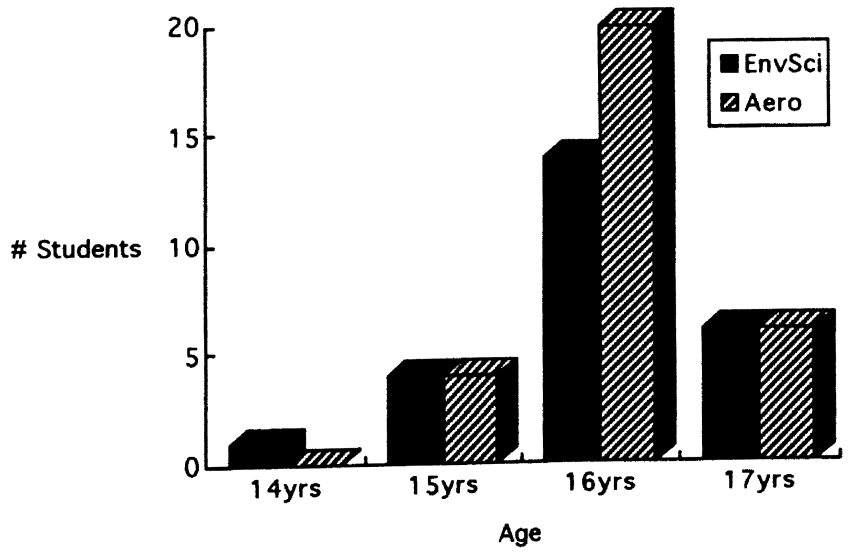

Figure 4.1. Age of Participants in the EnvSci and Aero Groups.

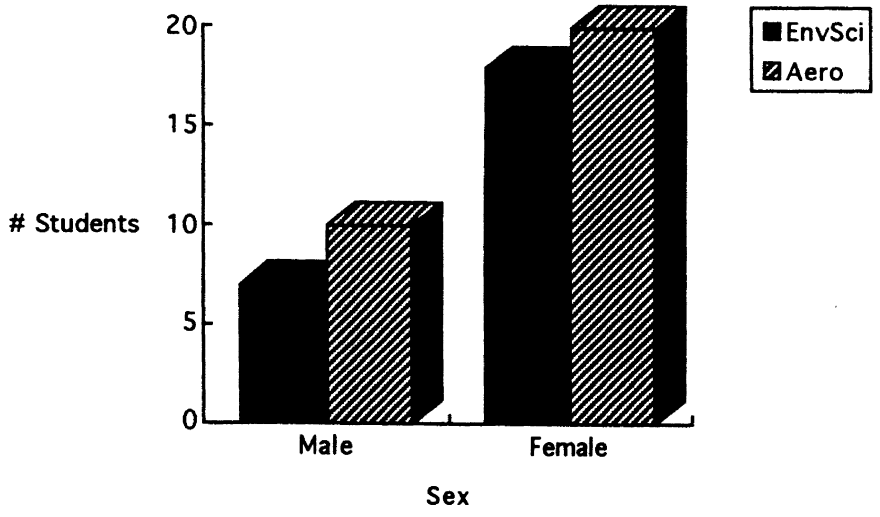

Figure 4.2. Sex of Participants in the EnvSci and Aero Groups.

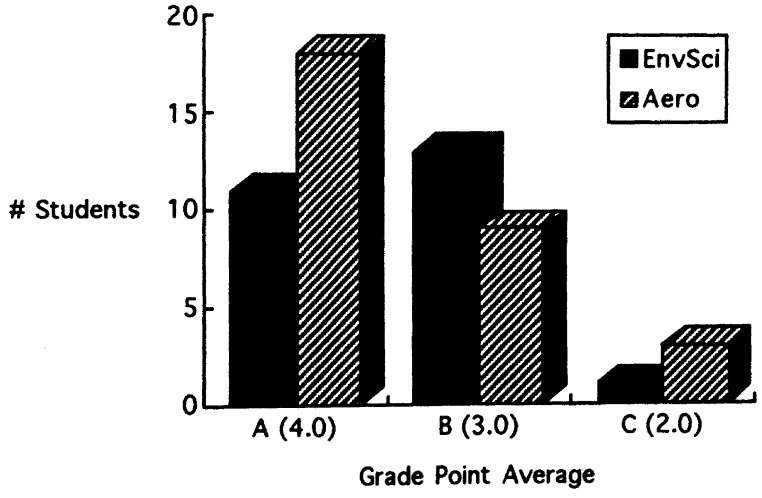

Figure 4.3. Approximate Grade Point Average of Participants in the EnvSci and Aero Groups.

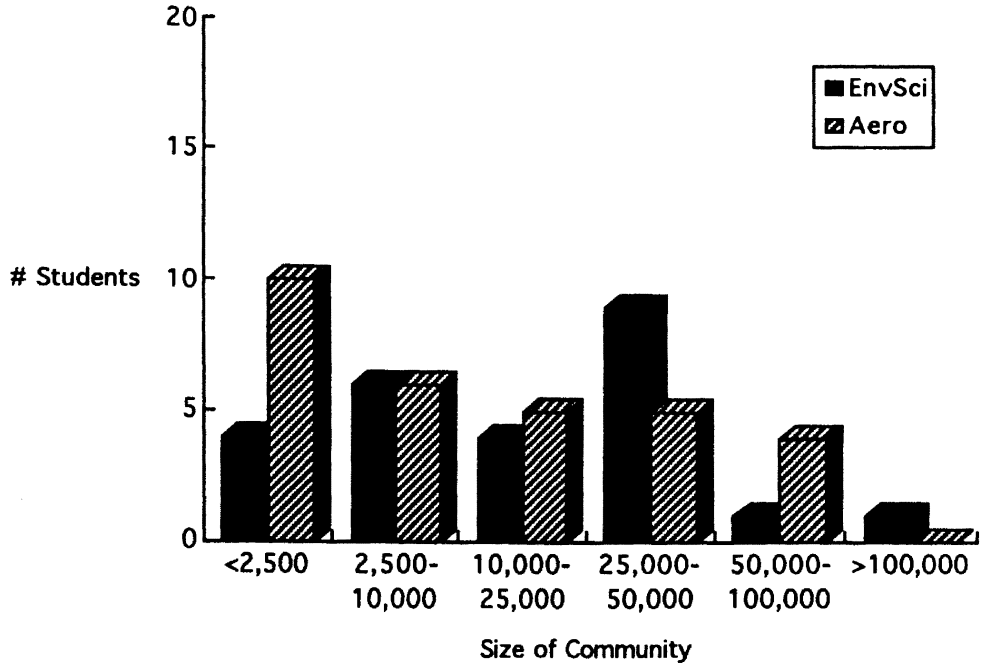

Figure 4.4. Approximate Size of Home Community for Participants in the EnvSci and Aero Groups.

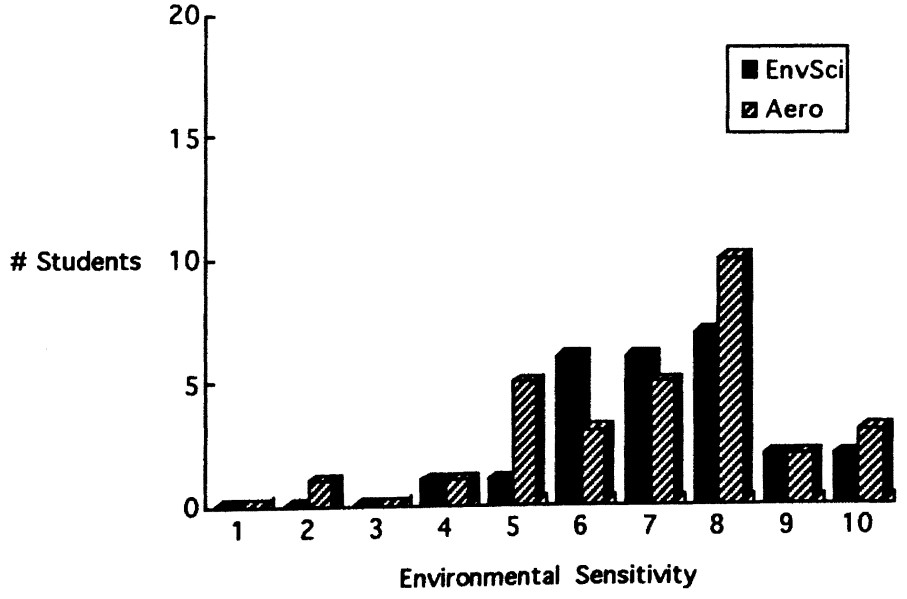

Figure 4.5. Self-Declared Environmental Sensitivity of Participants in the EnvSci and Aero Groups. A rating of one indicates low sensitivity and ten is a high level of sensitivity.

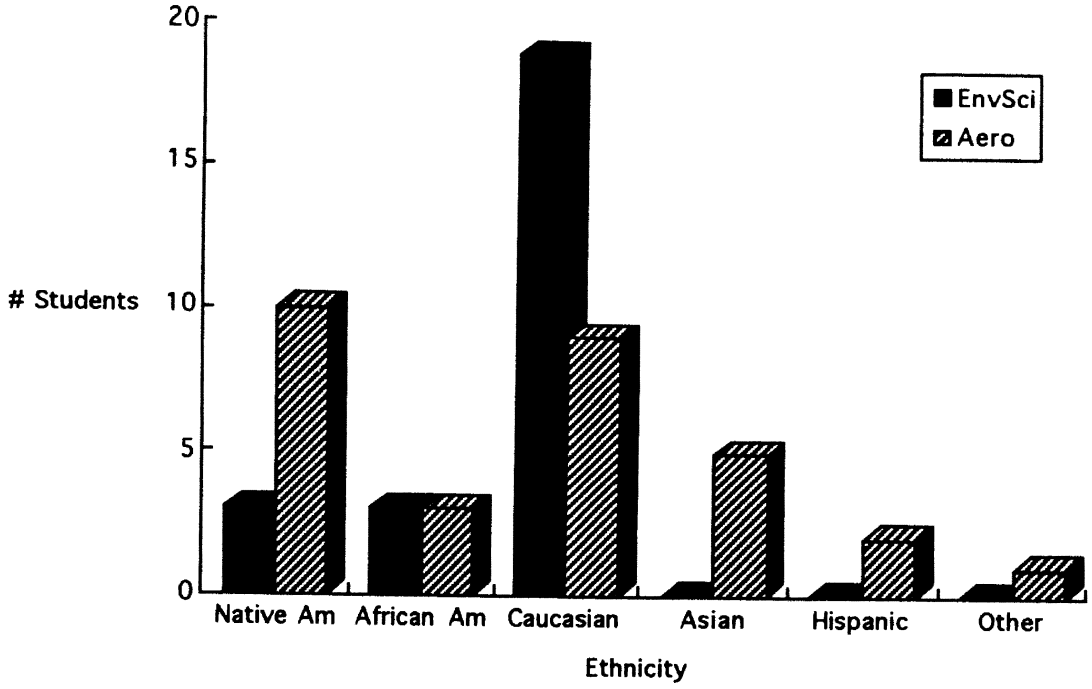

Figure 4.6. Ethnic Heritage of Participants in the EnvSci and Aero Groups.

Self-Concept

The first three research objectives (Chapter III) were to determine if the participants in the two academies exhibited a change in self-concept and if the two groups exhibited the same level of self-concept. Data obtained from the Tennessee Self-Concept Scale (Table I) show the mean scores for the EnvSci group to be 339.28 (SD=39.51), 339.96 (SD=38.63), and 339.39 (SD=46.95) at the pretest, posttest, and delayed posttest, respectively. The mean score for the Aero group on the pretest was 342 with a standard deviation of 32.8 and decreased to a mean score of 337 with a standard deviation of 44.6 at the posttest.

TABLE I

MEAN AND STANDARD DEVIATION FOR THE TENNESSEE SELF-CONCEPT SCALE

			Tennessee Self-Concept Scale	
Group	Admin	n	Mean	SD
EnvSci	Pre	25	339.28	39.51
	Post	25	339.96	38.63
	DPost	23	339.39	46.95
Aero	Pre	29	342.07	32.84
	Post	26	337.00	44.60

The results of both the one-factor and two-factor analyses of variance for repeated measures, as shown in Tables II and III, respectively, indicate no significant differences between the EnvSci group and the Aero group on self-concept, as measured by the Tennessee Self-Concept Scale. Figure 4.7 indicates a group by test interaction although it is not statistically significant.

TABLE II

ANALYSIS OF VARIANCE OF THE TENNESSEE SELF-CONCEPT SCALE FOR ENVSCI GROUP

Source	df	SS	MS	F	Level of Significance
Test	2	117.48	58.74	.19	NS
Error	44	13609.19	309.30		

TABLE III

ANALYSIS OF VARIANCE OF THE TENNESSEE SELF-CONCEPT SCALE FOR ENVSCI AND AERO GROUPS

Source	df	SS	MS	F	Level of Significance
Group	1	.26	.26	<.01	NS
Error	49	140981.76	2877.18		
Test	1	121.05	121.05	.58	NS
Group X Test	1	208.39	208.39	1.00	NS
Error	49	10165.20	207.45		

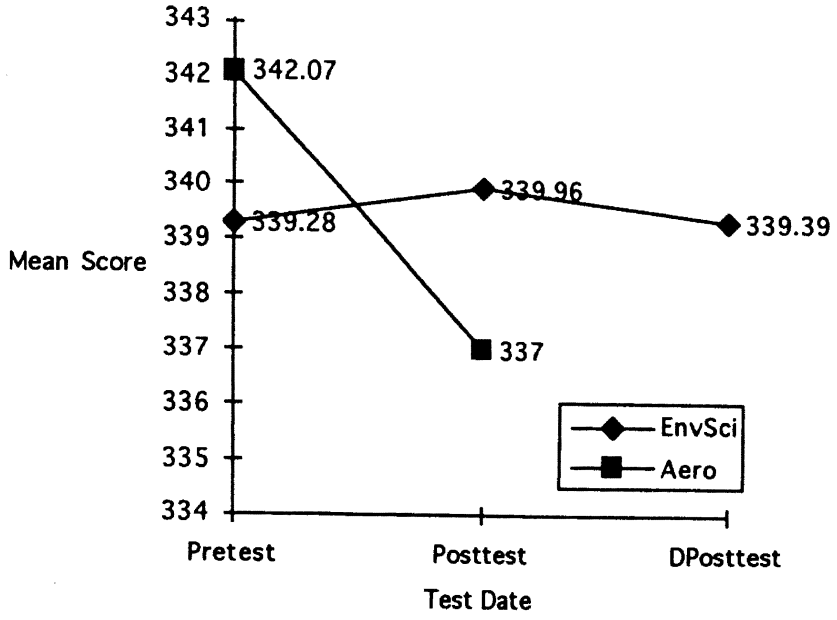

Figure 4.7. Interaction Effect of Self-Concept for EnvSci and Aero Groups.

No significant differences were found for either group; therefore, we fail to reject $H_o{}^{1a}$, $H_o{}^{1b}$, $H_o{}^{1c}$, and $H_o{}^{2}$ (Chapter III). Differences in self-concept between the two groups were measured by a two-factor ANOVA for repeated measures (Table III). The mean scores for environmental science participants remained stable and the mean scores for aerospace participants decreased (Figure 4.7). No statistically significant differences were found, thus, we fail to reject $H_o{}^{3a}$ and $H_o{}^{3b}$ (Chapter III).

Validity of responses to the Tennessee Self-Concept Scale (TSCS) may be verified with scores on the Self-Criticism and Distribution Scales of the TSCS. Responses on the Self-Criticism Scale of the Tennessee Self-Concept Scale (Table IV) show a pattern of faking (<27) by a small proportion of the students. Only one individual's score was in the cry for help (>49) category on

the pretest for the comparison group. Therefore, nearly all of the scores for individuals were in the normal range of scores for self-criticism.

TABLE IV

RESPONSE PATTERN ON THE SELF-CRITICISM SCALE OF THE TENNESSEE SELF-CONCEPT SCALE

			Self-Criticism Scale of TSCS		
Group	Admin	n	Faking (<27)	Normal	Cry for Help (>49)
EnvSci	Pre	25	1	24	0
	Post	25	1	24	0
	DPost	23	0	23	0
Aero	Pre	29	4	24	1
	Post	26	1	25	0

The Distribution Scale of the Tennessee Self-Concept Scale (Table V) indicates if responses are guarded (<85), normal, or stereotyped (>170). Several students responded in a guarded fashion at each administration. Also, one individual's response was stereotyped for each administration, except the delayed posttest for the experimental group. The pattern of responses on the Distribution Scale may indicate a lack of honesty or understanding in responding to items from the Tennessee Self-Concept Scale.

TABLE V

RESPONSE PATTERN ON THE DISTRIBUTION SCALE OF THE TENNESSEE SELF-CONCEPT SCALE

			Distribution Scale of TSCS		
Group	Admin	n	Guarded (<85)	Normal	Stereotyped (>170)
EnvSci	Pre	25	4	20	1
	Post	25	6	18	1
	DPost	23	6	17	0
Aero	Pre	29	4	24	1
	Post	26	4	21	1

The total mean scores on the Tennessee Self-Concept Scale for both the EnvSci group and the Aero group centered around 340 (Table I). As mentioned in the discussion of the instrument, norms for adolescents have been established suggesting that a score of approximately 330 is normal. In addition, scores of about 35 on the Self-Criticism Scale and approximately 115 on the Distribution Scale could be expected for individuals in this age bracket (Roid & Fitts, 1989). The majority of students from the experimental and comparison groups scored in the normal range on both the Self-Criticism (Table IV) and Distribution (Table V) Scales of the TSCS. Results, therefore, indicate that participants in this investigation exhibited levels of self-concept considered to be typical for adolescents.

Individuals scoring at a normal level of self-concept would have the capacity to experience changes in self-concept either in a positive or a negative

direction. It was thought that the self-concept of students participating in each academy would change significantly; however, it is not surprising that statistical results did not suggest that such change occurred. One reason may be that although scores on the Self-Criticism Scale indicate most scores were normal, the response pattern on the Distribution Scale leads one to question the honesty or understanding of respondents. The Tennessee Self-Concept Scale contains several statements deemed to be sensitive by participating students. For example, one item, "I am popular with women", raised questions from the female students. The corresponding item, "I am popular with men", caused concern for male participants. Oral comments made by students while completing the instrument led to questions regarding the sincerity of the responses and suggested that students may have had a misunderstanding of several items. Statements of this nature could be particularly threatening to an adolescent.

Adolescence is often a time in which individuals are striving to identify who they are. It is probable that during this time of transition three weeks is inadequate time to create dramatic or lasting changes in self-concept. In addition, a prior discussion in Chapter II indicated that self-concept is often difficult to measure for several reasons, including: a lack of consensus on a definition of self-concept, multidimensionality of the construct leading to inappropriate measurement, and difficulty in measuring behavioral outcomes related to self-concept.

One final suggestion is that it may be true that no statistically significant changes in self-concept occurred. However, as previously mentioned, individuals need adequate time for reflection as a part of the learning process. The three weeks were so busy, students had little time for real reflection. Also, if self-concept and environmental responsibility are indeed correlated, a long-

term change in environmental responsibility may result in a change in self-concept. Excerpts from journals and poetry written by students during the Environmental Science Academy (Appendix G) would lead one to believe that increases in self-concept did, in fact, occur. It appears that physical activities, such as a challenge course or climbing a mountain or chat pile, facilitated students in meeting and overcoming obstacles. These conquered challenges led to feelings of accomplishment and self-worth. In contrast, a second type of activity leading to thoughts of self-worth was when students had an opportunity to sit alone in the woods. At these times individuals seemed to contemplate how small they were as only one part of their environment, yet how important they are to our earth's well-being. Positive growth in self-concept as observed by staff members of the academy is believed to have important implications for every day life. Individuals who feel they can make a difference can, in fact, make a difference regardless of whether they exhibit levels of self-concept that are considered normal or exceptionally high. These changes are educationally significant.

Environmental Responsibility

The following section presents the findings pertaining to environmental responsibility, including the results of the analyses of verbal commitment, actual commitment, and the action assessment. A discussion regarding the results for environmental responsibility concludes the section.

Research objectives four through six (Chapter III) are to determine if EnvSci and Aero participants exhibit a change in environmental responsibility and if the two groups demonstrate the same level of environmental responsibility. Mean scores and standard deviation for verbal commitment are shown in Table VI. For the EnvSci group, the mean score of 7.92 (SD=1.75) at

the pretest increased to 8.72 (SD=1.33) at the posttest , and leveled off at 8.40 (SD=1.38) at the delayed posttest. The Aero group began with a mean score of 7.06 and a corresponding standard deviation of 2.05 and decreased to a mean score of 5.50 (SD=2.78) at the posttest.

TABLE VI

MEAN AND STANDARD DEVIATION FOR THE VERBAL COMMITMENT AND ACTUAL COMMITMENT SUBSCALES OF THE ECOLOGY SCALE

			Verbal Commitment		Actual Commitment	
Group	Admin	n	Mean	SD	Mean	SD
EnvSci	Pre	25	7.92	1.75	4.48	2.10
	Post	25	8.72	1.33	6.32	1.74
	DPost	25	8.40	1.38	7.40	1.19
Aero	Pre	30	7.07	2.05	3.33	2.02
	Post	26	5.50	2.78	3.15	2.69

One-factor analysis of variance for verbal commitment shows a significant test effect at the .05 probability level for the EnvSci group (Table VII). Also, the two-factor analysis of variance (Table VIII) indicates significant group by test interaction ($p<.01$) and a significant group effect ($p<.01$). The interaction effect of verbal commitment for the EnvSci and Aero groups may be seen in Figure 4.8.

TABLE VII

ANALYSIS OF VARIANCE OF VERBAL COMMITMENT FOR ENVSCI GROUP

Source	df	SS	MS	F	Level of Significance
Test	2	8.11	4.05	3.70	.05
Error	48	52.56	1.09		

TABLE VIII

ANALYSIS OF VARIANCE OF VERBAL COMMITMENT FOR ENVSCI AND AERO GROUPS

Source	df	SS	MS	F	Level of Significance
Group	1	103.22	103.22	13.97	.01
Error	49	361.96	7.39		
Test	1	4.24	4.24	3.24	NS
Group X Test	1	37.18	37.18	28.43	.01
Error	49	64.08	1.31		

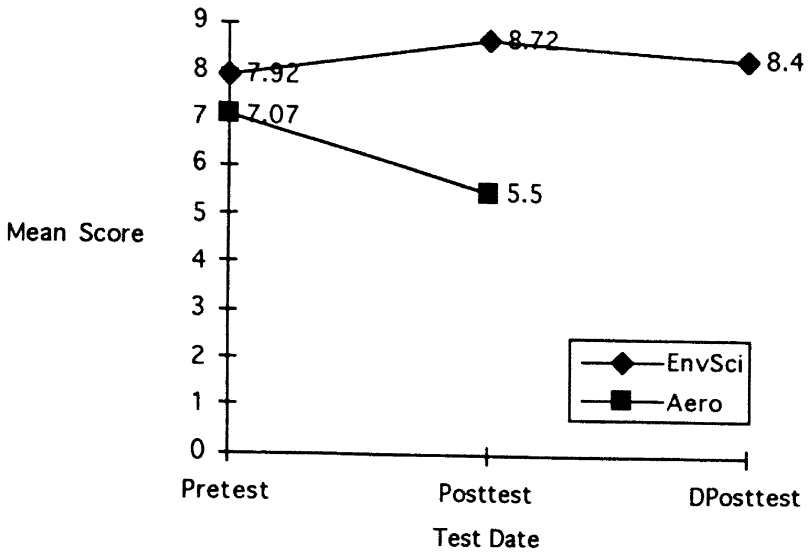

Figure 4.8. Interaction Effect of Verbal Commitment for EnvSci and Aero Groups.

Significant differences among and between the groups found by the analyses of variance indicated a need for further analysis, using the Student's t-test, to determine specifically where differences in verbal commitment occurred. A series of paired t-tests (Table IX) show that the EnvSci group increased significantly from the pretest to the posttest, but differences between the posttest and delayed posttest, and between the pretest and delayed posttest were not significant. Therefore, changes in verbal commitment for Environmental Science Academy participants were short-lived. A significant decrease in verbal commitment occurred from pretest to posttest for participants of the aerospace group.

Independent t-tests were utilized to compare the experimental and comparison groups (Table X). The two groups were not significantly different at the pretest, but were at the posttest. This difference at the posttest would be

expected since the EnvSci group had increased in verbal commitment throughout the academy, while the Aero group had exhibited a decrease in verbal commitment. Figure 4.9 demonstrates where significant differences in verbal commitment exist among and between the two groups.

TABLE IX

PAIRED T-TESTS FOR VERBAL COMMITMENT

Comparison	n	$Mean_1$	SD_1	$Mean_2$	SD_2	t	Sig.
ESPre vs ESPost	25	7.92	1.75	8.72	1.33	-2.77	.05
ESPost vs ESDPost	25	8.72	1.33	8.40	1.38	1.28	NS
ESPre vs ESDPost	25	7.92	1.75	8.40	1.38	-1.40	NS
AeroPre vs AeroPost	26	7.11	2.14	5.50	2.78	4.66	.01

TABLE X

INDEPENDENT T-TESTS FOR VERBAL COMMITMENT

Comparison	n_1	$Mean_1$	SD_1	n_2	$Mean_2$	SD_2	t	Sig.
ESPre vs AeroPre	25	7.92	1.75	30	7.07	2.05	1.66	NS
ESPost vs AeroPost	25	8.72	1.33	26	5.50	2.78	5.29	.01

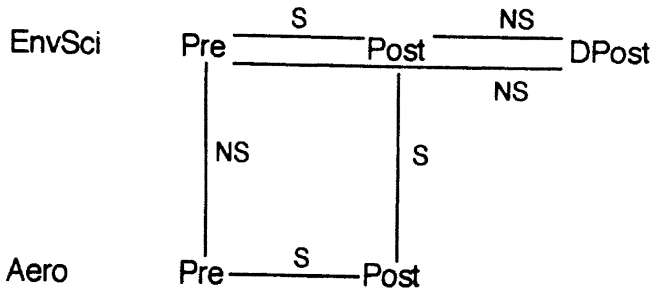

Figure 4.9. Results of T-Tests for Verbal Commitment Indicate if Differences Between Means are Significant (S) or Not Significant (NS) at the .05 Probability Level.

Data for actual commitment (Table VI) show a mean score of 4.48 and standard deviation of 2.10 at the outset for the EnvSci group. The mean score increased to 6.32 (SD=1.74) at the posttest and continued to increase to 7.40 (SD=1.19) at the delayed posttest for the EnvSci group. The Aero group had a mean score of 3.33 with a standard deviation of 2.02 at the pretest, while at the posttest the mean was 3.15 and the standard deviation was 2.69.

The one-factor analysis of variance (Table XI) shows a significant ($p<.01$) test effect for actual commitment regarding the experimental group. The two-factor analysis of variance (Table XII) indicates a significant group effect ($p<.01$), significant test effect ($p<.01$), and significant group by test interaction ($p<.01$). The interaction is illustrated in Figure 4.10

TABLE XI

ANALYSIS OF VARIANCE OF ACTUAL COMMITMENT FOR ENVSCI GROUP

Source	df	SS	MS	F	Level of Significance
Test	2	108.99	54.49	40.65	.01
Error	48	64.35	1.34		

TABLE XII

ANALYSIS OF VARIANCE OF ACTUAL COMMITMENT FOR ENVSCI AND AERO GROUPS

Source	df	SS	MS	F	Level of Significance
Group	1	115.73	115.73	15.23	.01
Error	49	372.23	7.60		
Test	1	16.50	16.50	8.17	.01
Group X Test	1	27.33	27.33	13.53	.01
Error	49	98.99	2.02		

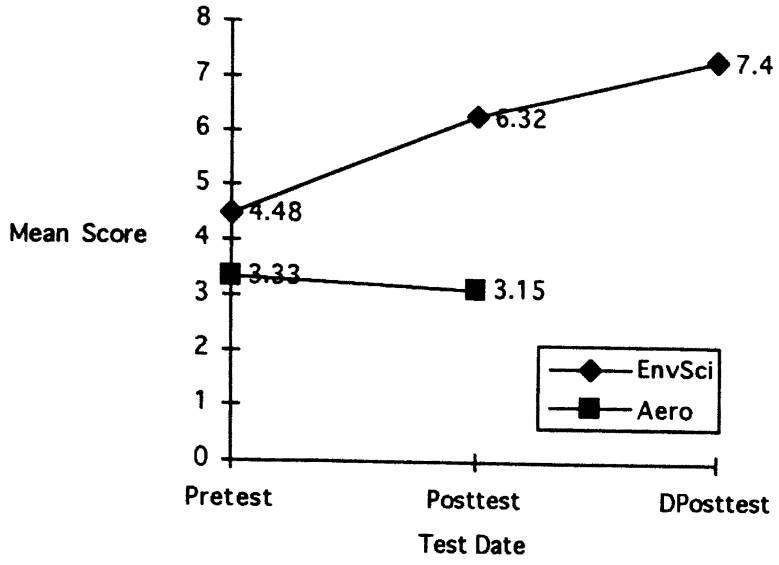

Figure 4.10. Interaction Effect of Actual Commitment for EnvSci and Aero Groups.

The analyses of variance regarding actual commitment indicated a need for further analysis to determine exactly where significant differences occurred among and between the EnvSci and Aero groups. The results of a series of paired t-tests (Table XIII) show significant increases for the EnvSci group between pretest and posttest and again from posttest to delayed posttest, resulting also in a significant difference between pretest and delayed posttest. Therefore, increases in actual commitment to environmental action were enduring for participants of the Environmental Science Academy. In contrast, the Aerospace group demonstrated no significant change in actual commitment.

Independent t-tests (Table XIV) indicate that the EnvSci and Aero groups were significantly different in actual commitment at the pretest and again at the posttest. A representation of where significant differences in actual commitment exist among and between the two groups may be seen in Figure 4.11.

TABLE XIII

PAIRED T-TESTS FOR ACTUAL COMMITMENT

Comparison	n	$Mean_1$	SD_1	$Mean_2$	SD_2	t	Sig.
ESPre vs ESPost	25	4.48	2.10	6.32	1.74	-4.82	.01
ESPost vs ESDPost	25	6.32	1.74	7.40	1.19	-4.55	.01
ESPre vs ESDPost	25	4.48	2.10	7.40	1.19	-8.44	.01
AeroPre vs AeroPost	26	3.38	2.09	3.15	2.69	0.56	NS

TABLE XIV

INDEPENDENT T-TESTS FOR ACTUAL COMMITMENT

Comparison	n_1	$Mean_1$	SD_1	n_2	$Mean_2$	SD_2	t	Sig.
ESPre vs AeroPre	25	4.48	2.10	30	3.33	2.02	2.05	.05
ESPost vs AeroPost	25	6.32	1.74	26	3.15	2.69	5.00	.01

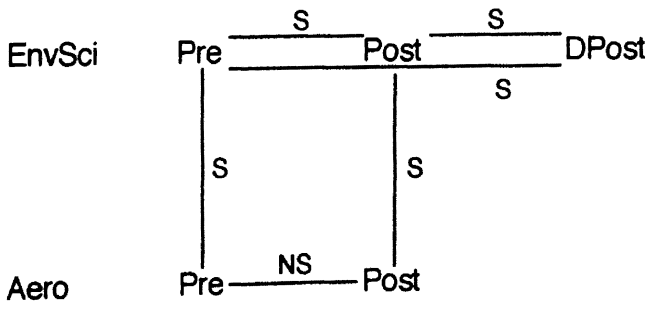

Figure 4.11. Results of T-Tests for Actual Commitment Indicate if Differences Between Means are Significant (S) or Not Significant (NS) at the .05 Probability Level.

Results of the Environmental Knowledge and Personal Environmental Action Assessment are shown in Figure 4.12. Environmental Science Academy participants reported environmental actions they had taken three months prior to and three months following the three week residential academy. Actions were classified into six categories: conservation and enhancement of resources, consumerism, recycling, communication and information, organizations, and clean-up projects. In each category the number of actions taken following the academy were greater than or equal to the number of actions taken prior to the academy. Initially there were 14 actions aimed at conservation and enhancement of resources; this increased to 16. Consumerism remained at ten actions both prior to and following the academy. Recycling activities increased from 19 to 33 and communication and information endeavors rose from six to 16. Involvement in organizations increased from four to six and clean-up projects remained at four.

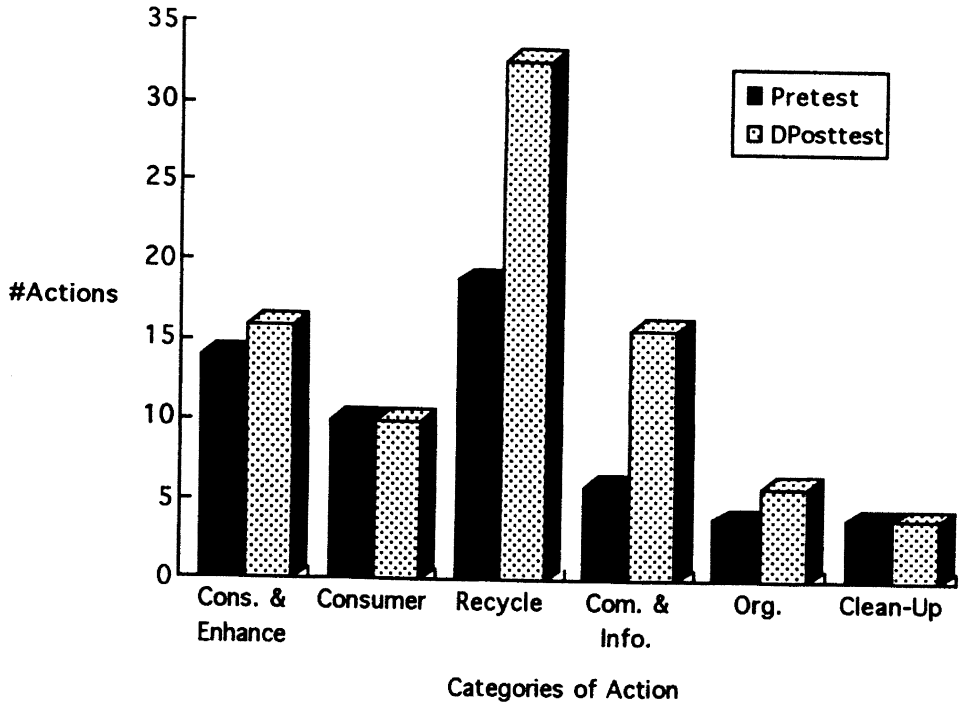

Figure 4.12. Number of Environmental Actions Taken by EnvSci Group Participants Before and After the Academy.

Results of statistical analyses led to the rejection of H_0^{4a}, H_0^{4d}, H_0^{4e}, H_0^{4f}, and H_0^{4g} (Chapter III). Aerospace participants exhibited a significant decrease in verbal commitment leading to the rejection of H_0^{5a} (Chapter III). There was no significant change in actual commitment for aerospace students.

Significant differences between the EnvSci and Aero groups were found at the posttest in verbal commitment and at both the pre- and posttest in actual commitment. Therefore, H_0^{6b}, H_0^{6c}, and H_0^{6d} (Chapter III) were rejected. As discussed previously, EnvSci participants increased in verbal commitment while Aero participants decreased. These differences in verbal commitment may be attributed to emphasis placed on different potential solutions (behavioral or technological) to environmental threats.

It is interesting to speculate as to why significant increases in actual commitment were enduring for EnvSci participants, while increases in verbal commitment were short-lived. It was expected that if different trends in verbal commitment and actual commitment existed it would be that verbal commitment, what an individual says they will do, would be higher than actual commitment, the actions an individual actually exhibits. The measured trends instead showed actual commitment to exceed verbal commitment; an anomaly. Perhaps this difference may be explained by the nature of the items in the Ecology Scale (see Appendix D). Statements in the Actual Commitment Subscale emphasized consumerism, communication and information, and organizations. In contrast, items in the Verbal Commitment Subscale focused on transportation and financial issues other than purchasing power. Students participating in the academy are at an age in which having their own car and accompanying independence are very important, a "luxury" they may be unwilling to forego. Also, financial issues may be something participants are indecisive about at this time in their lives. Purchasing "environmentally friendly" products, communication and information activities, and participating in environmental organizations are relatively inexpensive and convenient activities adolescents may pursue.

Scores for students in the Environmental Science Academy on the Verbal Commitment and Actual Commitment Subscales of the Ecology Scale were roughly equivalent to those for members of the Sierra Club in the Maloney, Ward, and Braucht (1975) study previously discussed. Also, they were comparable to scores made by teachers following a four-week, environmental institute in a study conducted by Edwards and Iozzi (1983). Aerospace participants scored lower on both verbal commitment and actual commitment than did students in the environmental program. On verbal

commitment aerospace students scored at a level similar to that of college students in the study conducted by Maloney, Ward, and Braucht (1975) at the pretest and decreased to the level of non-college adults at the posttest. Participants of the Aerospace Academy were similar to college students in actual commitment at both the pre- and posttests. Students in both groups exhibited levels of verbal and actual commitment such that there was room for change in either direction; an increase was desired.

Participants in the Environmental Science Academy exhibited significantly higher actual commitment than aerospace participants at the outset of the academies. This difference is not surprising since students apply to the programs they prefer, and thus are essentially self-selected into their respective research group. EnvSci participants exhibited an increase in actual commitment from pretest to posttest while Aero students did not. The schedule and curriculum for each of the programs may explain this difference. Environmental science students returned home during the first weekend of the three-week program (Appendix A). Several individuals took this opportunity to begin or expand recycling programs and other positive environmental actions. In addition, students were given the opportunity to write to their congressional representatives and to environmental organizations during computer sessions; thus opportunities for action were provided during the Environmental Science Academy. Participants in the Aerospace Academy (Appendix B) also returned home during the first weekend; however, environmental actions were not built into the curriculum.

Environmental responsibility was expected to increase for EnvSci students, yet not change for Aero participants. Environmental science students did in fact exhibit an increase in environmental responsibility. The aerospace participants, however, showed a decrease in verbal commitment and no

change in actual commitment. The reason for this decrease in verbal commitment may have been the lack of emphasis on environmental issues or perhaps due to a focus on technology in the aerospace curriculum (Appendix B).

Environmental responsibility is the cornerstone on which the Environmental Science Academy is built. It is believed that the actions of people are crucial to alleviating environmental problems. Emphasis is placed on gathering, synthesizing, and evaluating information, then making a decision and acting on that decision. In contrast, the Aerospace Academy emphasizes tremendous technological advances of humankind. This focus may facilitate individuals in deciding that technology may be utilized to remedy detrimental situations that may arise concerning the environment rather than changes in human behavior. In fact, there are instances where recent technological advances have functioned to remediate existing environmental problems and to reduce further hazards. While technology may be helpful, proponents of the Environmental Science Academy believe that, ultimately, changes must occur in human behavior in order to effectively address environmental problems.

This decrease in verbal commitment for aerospace students may have important implications for traditional science curricula in our secondary schools. Often secondary schools offer a variety of science courses, each taught as a separate discipline. While such classes are appropriate, they may fail to adequately address the interdisciplinary characteristics of our environment and the diverse methods that may be employed to remediate problems. Students in these courses may demonstrate a decrease in verbal commitment like those in the Aerospace Academy.

Correlations

Because environmental responsibility was measured in two parts, verbal commitment and actual commitment, each of these components was tested for their relationship to one another and to self-concept in response to research objectives seven and eight (Chapter III). A Pearson r correlation coefficient was calculated for the relationship between verbal commitment and actual commitment, between verbal commitment and self-concept (TSCS), and between actual commitment and self-concept (TSCS). Tables XV through XIX show the correlation coefficients for each administration of the instruments to the experimental and comparison groups. Significant correlation coefficients ($p<.05$) were found for the relationship between verbal commitment and actual commitment at each administration for both groups leading to the rejection of H_o^{7a}, H_o^{7b} H_o^{7c} H_o^{7d}, and H_o^{7e} (Chapter III). The relationship between actual commitment and self-concept was found to be significant ($p<.05$) at the pretest for the EnvSci group, therefore H_o^{8f} (Chapter III) must be rejected. No other statistically significant correlations were found.

TABLE XV

RELATIONSHIP OF VERBAL COMMITMENT, ACTUAL COMMITMENT, AND SELF-CONCEPT (TSCS): CORRELATION COEFFICIENTS FOR ENVSCI GROUP AT PRETEST

	Verbal Commit.	Actual Commit.	TSCS
Verbal Commit.	1.00	.56**	.27
Actual Commit.		1.00	.55**
TSCS			1.00

** Significant at the .01 level (two-tailed)

TABLE XVI

RELATIONSHIP OF VERBAL COMMITMENT, ACTUAL COMMITMENT, AND SELF-CONCEPT (TSCS): CORRELATION COEFFICIENTS FOR ENVSCI GROUP AT POSTTEST

	Verbal Commit.	Actual Commit.	TSCS
Verbal Commit.	1.00	.43*	.18
Actual Commit.		1.00	.31
TSCS			1.00

* Significant at the .05 level (two-tailed)

TABLE XVII

RELATIONSHIP OF VERBAL COMMITMENT, ACTUAL COMMITMENT, AND SELF-CONCEPT (TSCS): CORRELATION COEFFICIENTS FOR ENVSCI GROUP AT DELAYED POSTTEST

	Verbal Commit.	Actual Commit.	TSCS
Verbal Commit.	1.00	.53**	-.07
Actual Commit.		1.00	.17
TSCS			1.00

** Significant at the .01 level (two-tailed)

TABLE XVIII

RELATIONSHIP OF VERBAL COMMITMENT, ACTUAL COMMITMENT, AND SELF-CONCEPT (TSCS): CORRELATION COEFFICIENTS FOR AERO GROUP AT PRETEST

	Verbal Commit.	Actual Commit.	TSCS
Verbal Commit.	1.00	.47**	.03
Actual Commit.		1.00	.04
TSCS			1.00

** Significant at the .01 level (two-tailed)

TABLE XIX

RELATIONSHIP OF VERBAL COMMITMENT, ACTUAL COMMITMENT, AND SELF-CONCEPT (TSCS): CORRELATION COEFFICIENTS FOR AERO GROUP AT POSTTEST

	Verbal Commit.	Actual Commit.	TSCS
Verbal Commit.	1.00	.53**	.21
Actual Commit.		1.00	-.25
TSCS			1.00

** Significant at the .01 level (two-tailed)

Significant positive correlations between verbal commitment and actual commitment for environmentally responsible actions can be expected, particularly for individuals who have acted responsibly toward the environment previously. The significant positive correlation between verbal commitment and actual commitment is interesting when reflecting on the trends for the experimental and comparison groups. For EnvSci participants there was a short-term increase in verbal commitment and a longer lasting increase in actual commitment. Verbal commitment decreased for aerospace students while actual commitment did not change. Although the correlation was statistically significant at each administration for both groups, the magnitude of the correlation coefficients, at approximately .5, is moderate. The correlation between verbal and actual commitment is a point for further investigation.

There were practically no correlations between self-concept and environmental responsibility. As discussed in Chapter II, self-concept is believed to be positively correlated with socially responsible behavior. This behavior may take on many forms, one of which is environmentally responsible

behavior. Persons with positive self-concept may choose to behave in ways that are socially responsible, although possibly not intentionally directed toward the environment. It is encouraging to note that while no statistically significant correlations between self-concept and environmental responsibility were established, individuals with normal levels of self-concept can be and are environmentally responsible.

Summary

In summary, this investigation did not detect significant change in self-concept for participants in the EnvSci group or the Aero group. Nor did the two groups differ from one another in level of self-concept.

Students of the Environmental Science Academy did exhibit a significant increase in environmental responsibility, as evident from an increase in verbal commitment, although short-lived, an enduring increase in actual commitment to environmental action, and an increase in the number of actions students had taken following the academy. Aerospace Education Academy participants showed mixed results regarding environmental responsibility; a significant decrease in verbal commitment occurred, while there was no change in actual commitment. The EnvSci and Aero groups were similar in verbal commitment at the outset, but the EnvSci group was significantly higher at the posttest. In actual commitment, the EnvSci group was significantly higher at both the pretest and the posttest.

Correlation coefficients were calculated indicating a significant positive correlation between verbal commitment and actual commitment. However, overall there appeared to be no significant correlation between environmental responsibility and self-concept.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Self-concept, the way one perceives and feels about oneself, strongly influences the type of behavior an individual exhibits. If one thinks highly of oneself, he or she will act in socially responsible ways. Negative self-perceptions often lead to socially inappropriate behavior and ultimately may result in social problems, including environmental and ecological threats. If this is the case, methods for enhancing self-concept should also aid in promoting environmental responsibility. The High School Summer Academy for Environmental Science, a three-week residential program for tenth through twelfth grade students, incorporates strategies believed to increase self-concept and environmentally responsible behavior. The purpose of this investigation was to determine if the Environmental Science Academy and a similar, non-environmental program (aerospace education) conducted during the same period of time, were effective in facilitating change in self-concept and environmental responsibility.

Conclusions

The results of this investigation concerning the effects of an environmental science program and a comparison group (aerospace education) are as follows: (1) Students who participated in the Environmental

Science Academy showed no statistically significant changes in self-concept, (2) nor did participants of the Aerospace Academy. (3) There were no statistically significant differences in self-concept between participants in the environmental program and those in the aerospace program. (4) Environmental Science Academy participants exhibited a significant increase in environmental responsibility shown by increases in both verbal and actual commitment. (5) Students participating in the Aerospace Academy showed a significant decrease in verbal commitment and no change in actual commitment. (6) Environmental science students exhibited a significantly different and more desirable trend of environmental responsibility than students who participated in the Aerospace Academy. Environmental Science Academy participants were similar to aerospace participants in verbal commitment at the outset, yet became significantly greater at the posttest. Environmental participants exhibited significantly higher actual commitment than aerospace students throughout the investigation. (7) A significant, positive correlation was shown to exist between the two components of environmental responsibility: verbal commitment and actual commitment for environmental actions. (8) Little or no relationship was shown to exist between self-concept and environmental responsibility.

The Environmental Science Academy model is a three-week residential, experiential, and interdisciplinary program which incorporates a variety of learning techniques including cooperative learning and values clarification. Students entered the program with normal levels of self-concept and moderate to high levels of environmental responsibility as measured by verbal commitment and actual commitment to environmental actions. Although participants exhibited no statistically significant change in self-concept, they did demonstrate increases in environmental responsibility. Two components of

environmental responsibility, verbal and actual commitment, were shown to be positively correlated to one another while no significant correlation between self-concept and environmental responsibility was detected. It is encouraging to note, however, that typical adolescents with normal self-concept can and do exhibit increases in environmental responsibility. The Environmental Science Academy is deemed to be effective in promoting environmental responsibility and should serve as a model program throughout the nation.

Recommendations

In the process of reviewing literature, gathering data, and attempting to answer the questions outlined by this study; the author found several areas in which it is believed further research is needed. First, self-concept plays a major role in the well-being of individuals and our society. As such, research should continue in an effort to more adequately define self-concept and related terms and to measure a person's views of self and the behavioral outcomes.

Secondly, one point of interest that surfaced from this research was the decline in verbal commitment exhibited by participants in the comparison group. This change should be investigated further to determine if emphasis placed on technological advances may be a causal factor for decreased verbal commitment to act in an environmentally responsible manner.

Third, although a positive correlation was demonstrated between verbal commitment and actual commitment, verbal commitment decreased for aerospace participants and did not increase over the same period of time as actual commitment for environmental students. Not only is the decrease in verbal commitment for participants of the Aerospace Academy of interest, but also the short-lived increase in verbal commitment for students participating in the environmental science academy. Can the differences between verbal

commitment and actual commitment be attributed to the nature of the items in the instrument or are there other factors?

Finally, it is recommended that the Environmental Science Academy continually be evaluated. Behavioral outcomes of participants may be measured over an extended period of time and environmental responsibility may be compared to past and future groups. Also, coordinators for the academy must continue to evaluate and implement effective strategies for facilitating personal growth and environmental responsibility. The Environmental Science Academy is a model program and similar programs should be implemented by universities across the nation.

Overview

The 1992 Oklahoma State Regents for Higher Education High School Summer Academy for Environmental Science: Science, Technology, and Societal Interactions was a three-week residential, experiential, and interdisciplinary program. Statistical analyses indicate that the academy was effective in facilitating significant changes in environmental responsibility for its participants. Although statistically significant changes in self-concept were not detected, academy staff observed many personal changes in academy participants. In fact, it has often been said that environmental science academy participants "literally grew in front of the staff's eyes - grew in maturity, responsibility, self-perceptions, compassion, understanding, awareness, and tolerance." These changes are of great educational and societal significance. The academy has been successful in not only achieving its stated goals of moving students from "awareness to action," but also in meeting additional affective needs. The Environmental Science Academy model is effective

because, as Knapp (1989) suggests, it continually addresses "what is 'academic' and basic for meeting life's challenges."

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APPENDIXES

APPENDIX A

ENVIRONMENTAL SCIENCE ACADEMY

ENVIRONMENTAL SCIENCE ACADEMY

Goals

The purpose of the Oklahoma State University Summer Academy for Environmental Science: Science, Technology, and Societal Interaction was to conduct an intensive three-week program of study, with follow-up activities, for twenty-five eleventh and twelfth grade Oklahoma high school students interested in environmental science. The overall goal of the academy for environmental science was to make a select group of high school students: (1) aware of major environmental issues and problems; (2) knowledgeable about the ecological concepts that connect the issues and problems; and (3) able to identify the existing opportunities they have to deal with the problems now and in the future.

Design

The academy was designed in two phases. The first phase took place on the Oklahoma State University campus from June 6, 1992 through June 27, 1992, and it involved classroom, laboratory, and field instruction. Four 1991 academy participants were brought back the first weekend to serve as junior counselors. They helped with registration, team-taught several activities, and conducted an informal discussion with new participants about their academy experiences and effects it had on their personal lives.

The second phase involved follow-up activities in the form of a home analysis of use patterns for energy, water, toxics, solid waste recycling, and transportation. The Earth Day 1990 Home Survey was the model used for gathering the data. Students brought their data back to campus for the Fall Equinox weekend, September 19-20, 1992 to summarize and analyze their

findings. Students were also instructed to conduct and/or initiate a community action project upon completion of the academy in June. Each participant gave a presentation of their project at the reunion. During the academy the participants wrote to their representative in congress about environmental issues that they were personally concerned about. Those participants attending the reunion reported on the response they received.

Curriculum

The students participated during the three-week program in a variety of learning styles - lectures, seminars, simulations, research teams, discussion groups, laboratories, and field trips - planned around the study of Oklahoma's major biomes and major environmental issues confronting Oklahoma, the United States, and the world.

The state of Oklahoma was divided into four major quadrants and then the field trips were planned around local environmental issues of each representative quadrant. The southeastern Oklahoma trip concentrated on the timber and poultry industries, southwestern Oklahoma on federal and state government resource interactions, northwestern Oklahoma on geological and agricultural differences, and northeastern Oklahoma on the Tar Creek Superfund site, the Illinois River watershed, and the petroleum industry. Local field trips were conducted in central Oklahoma to several electric energy source sites and to waste management facilities. On-campus activities included lectures and discussions about the issues discussed on the field trips.

A significant portion of time during the three-week program was spent with the students working together in teams. Each team constructed a computer data base of required information about each area they visited on field trips.

The teams used the data collected using water and soil test kits to compile their data base. This data was recorded in a field data workbook.

Selection of Participants

Participants were selected from applications received from across the state. Twenty-five students participated in the academy and fourteen students returned for the reunion. Selection criteria included: (1) academic potential as measured by an acceptable grade point average, (2) leadership potential, (3) student's letter of application, and (4) documented member of an under-represented minority group.

Student Evaluation

Student progress was monitored by several methods. To promote participation in the programs, questions covering the proposed week's programs and trips were administered each week. Also, the students (1) kept daily journals, not only of what they did but their reactions and analysis of the activities, (2) elected two representatives, male and female, who served as liaisons to the staff in regard to suggestions and planning, (3) formed research teams that completed a data base and submitted a final printout for evaluation, and (4) research teams developed a slide presentation of the three-week experience and these presentations were presented at the final awards banquet.

Faculty and Staff

The faculty, staff, and program contacts participating in the academy represented a broad base of scientific expertise. Included on the staff were high school science teachers, a high school computer teacher, a sociologist, a geologist, a science educator, and a state agency professional. The

administration, day by day coordination, student supervision, and a large proportion of the instruction was carried out by graduate students in the Oklahoma State University Environmental Science program.

A balance in the sex, race, and ethnic backgrounds of the professionals making up the staff was sought so that by example the instructional team presented positive images designed to strengthen all students' science career expectations and enhance their basic knowledge and skills. This balance significantly complemented the mix of the multi-ethnic, race, and sex of the participants in a program dealing with a multidisciplinary science.

Program Evaluation

Students completed an evaluation form at the conclusion of the academy and another evaluation at the conclusion of the weekend reunion. The evaluations from all participants proved to be very positive. Participants shared their comments, suggestions, and ideas about field trips, speakers, computer and field work, and assignments. Using a Likert Scale, the participants rated the speakers and field trips. Their suggestions are valid and will be given serious consideration in planning another academy.

Conclusion

The 1992 Oklahoma State University Summer Academy for Environmental Science was a comprehensive, interdisciplinary approach to promoting responsible environmental action. Lectures, seminars, simulations, research teams, discussion groups, laboratories, and field trips developed around major biomes of the state and related environmental issues were designed to make the experience meaningful and relevant, truly experiential. Further information regarding the Environmental Science Academy may be

directed to the Center for Environmental Education, 104A Industrial Building, Oklahoma State University, Stillwater, Oklahoma, 74078.

1992 OSU Summer Academy

for Environmental Science

Schedule

Saturday, June 6

11:00am--Registration
12:00pm--Lunch
1pm--Parents Meeting
2pm--Evaluation Surveys (pretest)
3pm--Project WILD Games
6pm--Dinner
7pm--Leisure and the Environment (Dr. Lowell Caneday)
9pm--Junior Counselors

Sunday, June 7

9am--Water Relay
10am--Water and Soil Tests
11:30am--Lunch
1pm--Canoeing
3pm--Junior Counselors leave
3:30pm--Survival game
6pm--Dinner
7pm--Social Ecology (Dr. Larry Perkins)
9pm--Videos

Monday, June 8

8am--Challenge Course
7pm--Check in Dorms

Tuesday, June 9

9am--Program Orientation
1pm--Ecogeography of Oklahoma (Dr. Ron Tyrl)
2pm--Field Trip Introduction
3:30pm--OSU Museum
6pm--Computers

Wednesday, June 10

7am--Load Vans
7:30am--Depart
9am--Greetings from Lt. Gov. Jack Mildren (State Capitol Bldg.)
9:30am--Consolidation of State Environmental Agencies (Assistant Attorney General Brita Haugland-Cantrell)
11:30am--Lunch at Harn Homestead
1pm--Oklahoma Department of Wildlife Conservation
Overnight at Cameron University, Lawton

Thursday, June 11

8am--Wichita Mountains Wildlife Refuge (Claudine Daniel)
Return to OSU

Friday, June 12

9am--Recap Field Trip
10am--Plastics and Recycling (Russ Peterson of Dolco Industries)
1pm--Tar Creek (Dr. Jack Vitek)
2pm--Computers
Check-out by 7pm

Saturday, June 13

Home

Sunday, June 14

Check-in by 4pm
5pm--Eskimo Joe's
7pm--Field Trip Introduction

Monday, June 15

7am--Load Vans
7:30am--Depart
9am--Tall Grass Prairie
10am--Harvey Payne of the Nature Conservancy
1pm--Phillips Petroleum
5:30pm--Woolaroc
Overnight at Osage Hills

Tuesday, June 16

7am--Load Vans
7:30am--Depart
8:15am--Sutton Avian Research Center
1pm--Tar Creek (John Mott)
Overnight at Riverside Camp

Wednesday, June 17

8am--Canoe Illinois River
3pm--Cherokee Heritage Center
Return to OSU

Thursday, June 18

8:30am--Load Vans
9am--Depart
10am--Sooner Coal-Fired Power Plant
12pm--Lunch at Sooner Lake and recap field trip
2pm--HEW Landfill/Recycling Plant (Mike Adams)
6pm--Introduction to field trip
6:30pm--Computers

Friday, June 19

7am--Load Vans
7:30am--Depart
10am--Little Sahara
1pm--Alabaster Caverns
3pm--Lone Mountain. Hazardous Waste Facility (Becky O'Dell)
Overnight at Great Salt Plains State Park

Saturday, June 20

8am--Great Salt Plains
Glass Mountains
Cimarron River
6pm--Save the Cimarron (Claire Newsom)
Return to OSU

Sunday, June 21

8am--Church/Slide Work
2pm--Picnic and recap field trip
6pm--Introduction to field trip
6:30pm--Computers

Monday, June 22

7am--Load vans
7:30am--Depart
8:30am--Baxter Pharmaseal
10:30am--Keystone Dam
2pm--Waste to Energy Facility
Overnight as Connors State College, Warner

Tuesday, June 23

7am--Load vans
7:30am--Depart
10am--OK Poultry Farms (Bill Hardin)
1pm--Kerr Center for Sustainable Agriculture
3pm--Talimena Drive
Kerr Arboretum
8pm--Citizen Action (Barbara Hicks)
Overnight at Whip Poor Will Cabins

Wednesday, June 24

7am--Load Vans
7:30am--Depart
9am--Tyson Poultry Processing Plant
1pm--Weyerhaeuser Nursery
3:30pm--Weyerhaeuser Plywood Plant
Return to OSU

Thursday, June 25

9am--Recap Field Trip
10am--Environmental Consumerism (Dr. Sue Williams and Dr. Sarah Kirby)
1pm--Slide Work
6pm--Computers

Friday, June 26

9am--Environmental Action
Evaluations (posttest)
1pm--Slide Work
7pm--Preview slide presentations

Saturday, June 27

11:30-2pm--Banquet, Student Union, Oklahoma Room
Check-out by 4pm

1992 OSU Summer Academy

For Environmental Science

Reunion Agenda

Saturday, September 19

11:00 am - 12:00 pm	Registration at Camp Redlands Lodge
12:00 pm - 1:00 pm	Lunch
1:00 pm - 2:00 pm	What Did Your Lunch Cost Wildlife?
2:30 pm - 3:30 pm	To Dam or Not To Dam
3:30 pm - 5:30 pm	Fun Time
5:30 pm - 7:00 pm	Cookout
7:00 pm - 8:00 pm	Evaluations (Delayed Posttest)
8:00 pm - 10:30 pm	Community Action Presentations and Survey Discussion
10:30 pm - 1:00 am	Videos
1:00 am	In Cabins

Sunday, September 20

8:00 am - 9:00 am	Breakfast
9:00 am - 11:00 am	Slide Selection for National Photography Contests
11#0 am - 12:30 pm	Lunch and Clean Up
1:00 pm	Adios, Amigos!

APPENDIX B

AEROSPACE EDUCATION ACADEMY

AEROSPACE EDUCATION ACADEMY

Goal

The purpose of the 1992 Oklahoma State University Aerospace Education High School Summer Academy was to provide a select group of high school students an opportunity to engage in active study of aerospace education concepts. Specific objectives of the Aerospace Academy are to: (1) nurture the interest of students in biology, chemistry, physics, earth science, and mathematics, and demonstrate how they can be integrated into aerospace education studies; (2) interest females and underrepresented minority groups in the sciences; and (3) conduct an evaluation of the summer academy for future research purposes.

Design and Curriculum

The Aerospace Academy was a three-week residential program offered June 7 through June 26, 1992. The first two weeks were devoted to curricular matters in aerospace education studies. During the third week students were provided with field experiences.

The curriculum for the first two weeks was basically one-half lecture and one-half hands-on classroom activities. Daily lectures emphasized aerospace education concepts, while activities during the evenings reinforced these concepts. Hands-on activities were often cooperative in nature with students working in small groups and involved much problem-solving. Guiding topics were aeronautics, astronomy, remote sensing, study of the space shuttle, and careers in space exploration and the aerospace industry. Computer technology was an area of focus. Students spent a significant amount of time learning about computers and simulating various flight conditions.

The third week was devoted to field experiences. These experiences further reinforced the mathematics and science concepts learned during the first two weeks of the academy, and identified how these concepts apply to the on site visitations as used by scientists, lab personnel, and support staff. In this manner, students had real-life experiences in talking with on-the-job personnel in the aerospace field.

Selection of Participants

The Aerospace Education Academy was designed for thirty students entering their junior or senior year in high school. Efforts to identify students who would be invited to participate in the summer academy were initiated with development of a brochure. The brochure was distributed to all high schools and to education and science organizations in the state of Oklahoma. The brochure contained an application for students to complete and return to Oklahoma State University. A selection committee served to screen applications and make recommendations to the co-directors of the academy as to which students the committee felt should be involved. The process was successful in targeting females and underrepresented minority groups for participation in the academy.

Faculty and Staff

The faculty of the summer academy was selected by the Department of Aviation and Space Education at Oklahoma State University. The faculty included an aviation education major at Oklahoma State University, three public school teachers, and a doctoral graduate assistant from the Aviation and Space Education Department.

Evaluation of Students and the Academy

The evaluation of the Aerospace Education High School Student Academy was conducted in two parts. The students were given a pretest upon arrival at the academy to determine their cognitive skills as well as attitudinal preferences towards aerospace education. At the conclusion of the academy, students were administered a posttest to measure cognitive and attitudinal changes which occurred during the three weeks of training. Students were also asked to complete a more subjective evaluation. This evaluation attempted to identify if the academy had provided students with new experiences, such as first flights, first time to visit a seashore, or first time to stay in a college dormitory. The third instrument requested that students evaluate each session of the academy on a five item scale ranging from "poor" to "super".

Conclusion

The 1992 Oklahoma State University Aerospace Education High School Summer Academy was a multidisciplinary program designed to integrate science into aerospace, facilitate career exploration in the aerospace industry, investigate ties between the aviation industry and Oklahoma's economy, and identify international aspects of space exploration. Lectures regarding key concepts in aerospace education were reinforced by hands-on activities and cooperative learning with emphasis on problem-solving and technology and technology transfer including simulations and computer experience. The academy attempted to link learning to potential careers of participating young people. Further information concerning the Oklahoma State University Aerospace Education High school Summer Academy may be obtained from the

Department of Aviation and Space Education, 300 North Cordell Hall, Oklahoma State University, Stillwater, Oklahoma 74078.

High School Summer Aerospace Academy

Oklahoma State University

Stillwater, Oklahoma

June 7-26, 1992

Sunday, June 7	
3:00-5:00pm	Move in to OSU dormitory (Participants)
5:00pm	Welcome (Dr. Steven Marks, Director)
	Orientation for students and parents
5:45pm	Picnic
6:30pm	Parents depart
7:00-10:00pm	T-shirt design (Participants)
	Get to know you activities (Marilyn McIntosh)
Monday, June 8	
8:30-9:00am	Pretest (Staff)
9:00-11:45am	Principles of Flight (Jamie Roberts)
1:15-3:30pm	Aircraft Performance (Jamie Roberts)
3:30-4:00pm	Press Photos (Dottie Witter)
4:00-6:00pm	Campus Tour (Dr. Kevin Allen)
6:00-7:30pm	Dinner
7:30-10:00pm	Construct Hot Air Balloons (Staff and Participants)
Tuesday, June 9	
8:00am-5:00pm	Challenge Course
7:30-10:00pm	Construct Hot Air Balloons (Staff and Participants)
Wednesday, June 10	
8:30-11:45am	Control Tower-Tulsa Riverside/Orientation Rides
1:15-4:30pm	Orientation Rides/Control Tower-Tulsa Riverside
6:00-7:30pm	Dinner
7:30-10:00pm	Kites (Staff and Participants)
Thursday, June 11	
8:30-11:45am	Flight Computers (Jamie Roberts)
1:15-4:00pm	Cross Country Flight Planning (Jamie Roberts)
4:00-6:00pm	Softball
6:00-7:30pm	Dinner
7:30-10:00pm	Kites (Staff and Participants)

Friday, June 12	
8:30-11:45am	Space Shuttle/Living in Space (Stanley Jones)
1:15-3:00pm	Paper Airplanes (Kevin Allen)
3:00pm	Return home for weekend
Sunday, June 14	
5:00-7:00pm	Return to OSU Campus
7:30-10:00pm	Construct Model Rockets (Staff and Participants)
Monday, June 15	
8:30-11:45am	Aviation Weather (Steve Marks)
	Weather Activities (Steve Marks)
1:15-4:00pm	Remote Sensing (Kevin Allen)
4:00-6:00pm	Swimming
6:00-7:30pm	Dinner
7:30-10:00pm	Construct Model Rockets (Staff and Participants)
Tuesday, June 16	
9:00-11:00am	Oklahoma Air Guard-OKC
12:30-2:00pm	Air and Space Museum
2:00-5:00pm	OKC Zoo
6:00-7:30pm	Dinner
7:30-10:00pm	Mars Project (Participants)
Wednesday, June 17	
8:30-11:45am	Astronomy (Steve Marks)
1:15-4:00pm	Space Station (Kevin Allen)
	Space Link (Kevin Allen)
	Build Hubble Space Telescope (Steve Marks)
	Kepler's Laws (Steve Marks)
4:00-6:00pm	Volleyball
6:00-7:30pm	Dinner
7:30-10:00pm	Delta Darts (Participants)
Thursday, June 18	
8:30-11:45am	FAA Center, OKC
1:15-4:30pm	FAA Center, OKC
6:00-7:30pm	Dinner
7:30-10:00pm	Mars Project (Participants)

Friday, June 19	
8:30-11:45am	Lunar Geology (Steve Marks) View Apollo 17 Lunar Samples
1:15-4:00pm	Egg Drop and Mars Project Models (Staff)
4:00-6:00pm	Pack for Trip
6:00-7:30pm	Dinner
7:30-10:00pm	Launch Model Rockets and Star Gazing (Staff) Movies and Popcorn

Saturday, June 20	
5:30am	Leave Stillwater for OKC Will Rogers Airport
9:00am	Depart Oklahoma City for Houston
2:00pm	Astros Baseball Game-LA Dodgers

Sunday, June 21	
10:00am	Houston Ship Channel Tour
12:00-6:00pm	Houston Museum of Natural History
1:00pm	Planetarium
3:00pm	IMAX Film Water Park

Monday, June 22	
9:00am-4:00pm	Tour Johnson Space Flight Center (JSC)
5:00-7:00pm	Pizza Party by Motel Pool for Dinner

Tuesday, June 23	
8:30-11:00am	View Rocket Park, JSC
1:00-3:00pm	Lone Star Flight Museum
3:00-8:00pm	Galveston Area
8:00pm	Return to Houston

Wednesday, June 24	
10:00am	Check out of Motel
12:50pm	Depart Houston for Oklahoma City
2:05pm	Arrive Oklahoma City
7:00-10:00pm	Movies

Thursday, June 25	
8:30-11:45am	Summary of Field Trip (Staff)
1:15-4:00pm	Prepare Video Presentation (Participants)
4:00-6:00pm	Swimming
7:30-10:00pm	Complete Reports (Participants)
Friday, June 26	
8:30-9:30am	Reflective Summary (Staff)
	Posttest (Staff)
	Clean-up Room and Pack for Departure
10:00am	Closing Program (Staff, Participants, and Parents)

APPENDIX C

DEMOGRAPHIC QUESTIONNAIRE

DEMOGRAPHIC QUESTIONNAIRE

Date _____

1. Name/Code # _____
2. Age _____
3. Highest grade completed in school:
   Sophomore _____ Junior _____ Senior _____
4. Sex: Male _____ Female _____
5. In school, are you a(n) A _____, B _____, C _____, or D _____ student?
6. Do you plan on going to college after you graduate from high school?
   Yes _____ No _____ Undecided _____
7. n what occupation do you wish to be employed after completing school? _____
8. What are the primary/major occupations of your parents?
   Father _____
   Mother _____
9. What is the population of the community in which you now live?
   below 2,500 _____ 25,001 - 50,000 _____
   - 10,000 _____ 50,000 - 100,000 _____
   - 25,000 _____ over 100,000 _____
10. Ethnic Group: Native American _____ Caucasian _____
    Afro-American _____ Asian _____
    Hispanic _____ Other _____
11. How many languages are spoken in your home?
    _____
12. High School Academy you are attending?
    Name _____
    Date _____
13. Why did you choose this academy?
    _____
14. Have you attended an Academy prior to this one? Yes _____ No _____

15. f you answered YES in #14, what was its name and time you attended it?
    Name _____
    Fall _____ Winter _____ Spring _____ Summer _____ , 19 _____

16. Have you previously taken any junior or senior high classes or attended any workshops that dealt with conservation and/or environmental concerns?
    Number of classes? _____ workshops? _____ none _____

17. Do you belong to any conservation and/or environmental organizations, for example, National Wildlife Federation, Sierra Club, School Environmental Club, etc.?
    Yes _____ No _____
    Organizations_____
    _____

18. Do your parents belong to any conservation and/or environmental organizations?
    Yes _____ No _____
    Organizations_____
    _____

19. Please provide your best estimate of your level of environmental sensitivity (i.e., your concern for the environment; viewing the environment from an empathetic perspective): Circle one of the numbers below.

    2 3 4 5 6 7 8 9 10
    low moderate high

APPENDIX D

ECOLOGY SCALE

ECOLOGY SCALE

Name/Code # _____
Date _____
Academy _____

Knowledge

Items 1 - 15 are multiple choice questions. Choose the best answer.

C 1. Soil pollution is generally due to: A) sparse rains, improper farming methods, C) poisonous metals, over fertilization, E) poor crop rotation.

A 2. Most smog in our big cities comes from: A) automobiles, supersonic jets, C) industrial plants, D) large trucks, refuse disposal.

C 3. High concentrates of chlorinated hydrocarbon residues: cause sheep to die, B) are found in large amounts in our atmosphere, C) accumulate in flesh-eating birds and upset breeding behavior, D) are no longer legal in pesticides, are readily biodegradable.

C 4. Mercury has been found at unacceptable levels in : A) fruit, B) vegetables, C) seafood, D) beef, E) soft drinks.

B 5. Which of the following does not appreciably reduce the pollution by automobiles? A) properly tuned engine, high octane gas, C) low lead gas, D) smog control devices, E) propane engines.

E 6. The most common pollutants of water are: A) arsenic, silver nitrates, B) hydrocarbons, C) carbon monoxide, D) sulphur, calcium, E) nitrates, phosphates.

B 7. Ecology is best described as the study of: A) the relationship between humans and the environment, B) the relationship between organisms and the environment, C) pollution and its control, D) the environment, E) recycling of products.

D 8. Which of the following materials usually takes longest to decompose? A) tin, B) iron, C) copper, D) aluminum, E) steel.

B 9. Birds and fish are being poisoned by A) iron, B) mercury, silver, D) lead, E) magnesium.

__D__ 10. All but one of the following decompose in ocean water: sewage, B) garbage, C) tin cans, D) plastic bags, chemical fertilizer.

__E__ 11. What is the harmful effect of phosphates on marine life? causes cancer, B) renders fish sterile, C) induces nervous reactions in fish, D) makes water cloudy, feeds algae which suffocates fish.

__B__ 12. Which of the following well-known groups is primarily interested in conservation issues? A) Boy Scouts of America, The Sierra Club, C) Kiwanis, D) 4-H Club, The Ecology Association.

__A__ 13. Practically all of the lead in our atmosphere is caused by? A) cars, B) industrial plants, C) airplanes, D) burning refuse, E) cigarettes.

__C__ 14. DDT takes how long to deteriorate into harmless chemicals? it never does, B) 10-20 months depending on the weather, about 200 years, D) about 400 years, E) anywhere from several days to several years.

__B__ 15. Ecology assumes that man is: a (an) _____ part of nature. A) differential, B) integral, C) inconsequential, superior, E) original.

Affect

Items 16 - 25 are true/false statements. A = True, B = False.

__B__ 16. I feel people worry too much about pesticides on food products. A) True, B) False

__A__ 17. It frightens me to think that much of the food I eat is contaminated with pesticides. A) True, B) False

__A__ 18. It genuinely infuriates me to think that the government doesn't do more to help control pollution of the environment. A) True, B) False

__B__ 19. I feel fairly indifferent to the statement: "The world will be dead in 40 years if we don't remake the environment." True, B) False

__A__ 20. I become incensed when I think about the harm being done to plant and animal life by pollution. A) True, B) False

__B__ 21. I'm usually not bothered by so-called "noise pollution". True, B) False

__A__ 22. I get depressed on smoggy days. A) True, B) False

__A__ 23. When I think of the ways industries are polluting, I get frustrated and angry. A) True, B) False

__B__ 24. The whole pollution issue has never upset me too much since I feel it's somewhat overrated. A) True, B) False

__B__ 25. I rarely ever worry about the effects of smog on myself and family. A) True, B) False

Verbal Commitment

Items 26 - 35 are true/false statements. A = True, B = False.

__A__ 26. I'd be willing to ride a bicycle or take the bus to work in order to reduce air pollution. A) True, B) False

__B__ 27. I would probably never join a group or club which is concerned solely with ecological issues. A) True, B) False

__A__ 28. I would be willing to use a rapid transit system to help reduce air pollution. A) True, B) False

__B__ 29. I'm not willing to give up driving on a weekend due to a smog alert. A) True, B) False

__B__ 30. I'm really not willing to go out of my way to do much about ecology since that's the government's job. A) True, B) False

__A__ 31. I would donate a day's pay to a foundation to help improve the environment. A) True, B) False

__A__ 32. I would be willing to stop buying products from companies guilty of polluting the environment, even though it might be inconvenient. A) True, B) False

__A__ 33. I'd be willing to write my congressman weekly concerning ecological problems. A) True, B) False

__B__ 34. I probably wouldn't go house to house to distribute literature on the environment. A) True, B) False

__B__ 35. I would not be willing to pay a pollution tax even if it would considerably decrease the smog problem. A) True, B) False

Actual Commitment

Statements 36 - 45 are true/false statements. A = True, B = False.

__B__ 36. I guess I've never actually bought a product because it had a lower polluting effect. A) True, B) False

__A__ 37. I keep track of my congressman and senator's voting records on environmental issues. A) True, B) False

__B__ 38. I have never written a congressman concerning the pollution problems. A) True, B) False

__A__ 39. I have contacted a community agency to find out what I can do about pollution. A) True, B) False

__B__ 40. I don't make a special effort to buy products in recyclable containers. A) True, B) False

__A__ 41. I have attended a meeting of an organization specifically concerned with bettering the environment. A) True, False

__A__ 42. I have switched products for ecological reasons. A) True, False

__B__ 43. I have never joined a cleanup drive. A) True, B) False

__B__ 44. I have never attended a meeting related to ecology. True, B) False

__A__ 45. I subscribe to ecological publications. A) True, B) False

APPENDIX E

ENVIRONMENTAL KNOWLEDGE AND PERSONAL ENVIRONMENTAL ACTION ASSESSMENT

ENVIRONMENTAL KNOWLEDGE AND PERSONAL ENVIRONMENTAL ACTION ASSESSMENT

Name/Code # _____

Academy Name _____

Date _____

Task 1

Environmental issues are problems for humans because they have not been solved yet. This means that citizens must work toward solving these issues. As a citizen what kind of actions do you think you could take for helping solve environmental issues? Please list below as many different kinds of environmental actions as you can that could be taken by an individual in helping to remedy environmental problems.

_____
_____
_____
_____
_____
_____
_____
_____

Task 2

Have you taken any environmental actions which were directed at solving an environmental issue in the past three (3) months?
Yes _____ No _____
Why?_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Task 3

What were the individual actions you took within the past three (3) months?

1) _____

2) _____

3) _____

4) _____

5) _____

6) _____

7) _____

Task 4

What were the associated environmental issues you were working to solve?

1) _____

2) _____

3) _____

4) _____

5) _____

6) _____

7) _____

*Note: Use the back of this paper if you need more space.

APPENDIX F

CATEGORIES OF ACTION

CATEGORIES OF ACTION FROM THE ENVIRONMENTAL KNOWLEDGE AND PERSONAL ENVIRONMENTAL ACTION ASSESSMENT

Conservation and Enhancement of Resources
- Water
- Energy - car pool, walk, bike
- Electricity
- Release of wildlife
- Planting

Consumerism
- Purchase recycled product
- Limit purchase/use of paper, styrofoam, aerosols, animal tested, overpackaging
- Precycling

Recycling
- Cans, paper, glass, plastic, etc. (each item counted separately)
- Home/school/church
- Reuse
- Composting

Communication and Information
- Letters to congress
- Request information from organizations
- Speeches
- Writing articles
- Signs and displays
- Design environmental coloring book
- Teach and encourage

Organizations
- Begin organization
- Member

Clean-up Projects
- Adopt-a-Highway, park, or lake

APPENDIX G

ANECDOTAL DATA FROM STUDENT JOURNALS AND POETRY

ANECDOTAL DATA FROM STUDENT JOURNALS AND POETRY

Participants in the environmental science academy were asked to keep a journal throughout the three weeks of the program. Students were encouraged to not only write the events of each day, but also express their impressions and emotions. Additionally, students were provided with two opportunities to go alone to a place in a forest and write whatever came to mind; most wrote poetry.

These writings were read in an effort to identify development in self-concept and environmental responsibility. All entries regarding self-concept and environmental responsibility were compiled, none were negative statements. Several entries were selected as evidence to support measures of verbal and actual commitment to improve environmental quality suggesting that the academy was effective in facilitating personal growth and environmental responsibility.

The first two quotations address the nature of the environmental science academy as a learning process. If experiential education is defined to be relevant and meaningful to the learner, it would appear that the academy is indeed experiential.

> "My first reaction to this academy was that it was going to be a lot of hard work and studying. But instead I found that in order to learn you don't have to sit in a classroom all day and take tests. I think the way we're learning is much better and more interesting. You can learn in a classroom, but I think learning because you want to and you're interested you'll remember it all much longer than just memorizing stuff for tests."

> "It's totally different from school; everything I learn here is something I want to learn. I don't just listen to a professor just to get an "A". There is 'Leisure' found in all the activities and lectures."

Following is a poem and excerpts from student journals which indicate that participants were in a process of developing and/or changing their perceptions of self. Activities requiring much physical exertion seemed to challenge the limits of students and, once conquered, improved views of self.

> "Here I am
> Alone in the woods again.
> Oftentimes when I come here,
> My problems vanish-Not today.
> The slight running of a river
> And chirping of birds is all I hear.
> I am not lonely;
> I am just troubled
> I should be happier now.
> People, the scariest of creatures, are gone,
> and yet, I can't leave them behind right now.
> Much in the same way as life;
> though people trouble me,
> I find some that I instantly care about, Against my will.
> What if they do not care for me?
> Though I say and pretend I do not care,
> And oftentimes I don't,
> The people that I unwillingly care about
> May tire of my seemingly hopeless insecurity,
> They may tire of me.
> Then, I would have only me,
> I would have to learn to care for me.
> I am scared!"

> "So far, my most memorable experience has been the Ropes Course. Not only was it a new, exciting experience but it helped reinforce self-reliance and self-confidence."

> "I was feeling so confident and ecstatic that I practically leaped off the platform and went flying through the trees at 35mph. All the while letting out a cry of rejoice- I made it- I lived- I conquered- I challenged myself and prevailed- I got a great workout- and- I had a lot of fun!!!!"

"Afterwards, I felt like I could do anything and I lost my fear of heights."

"It's a great feeling when you can be proud. I could do anything, because I did everything."

"The ropes course was the most awesome thing I have ever done. It built up my confidence so much....It was such a challenge, but I feel I can do and conquer anything now."

"Climbing that mountain gave me a supreme source of satisfaction. As if to say that if I can climb that mountain I can do anything."

"...climbing the chat piles. How exhilarating!!! I didn't think I was going to make it, but I did and I'm proud of myself."

Several journal entries illustrate that students were constantly evaluating existing and potential environmental problems. Students strove to determine what their role in alleviating and preventing these situations should and would be. One issue addressed was the interconnectedness of people and their environment--if people destroy their environment, what happens to people?

"With the Earth,
We must take great care,
Because at this time
Her condition is no better than fair.
Her mountains are crumbling,
Her animals dying,
Her deserts expanding,
Her politicians lying.
Her trees are falling,
Her ozone depleting,
People are polluting--
and her eyes are weeping."

"Over the weekend I set special sacks for paper, aluminum cans and plastic and am going to stick with it this time."

"When I first found out that I was going to be coming here I thought wow! sounds like fun. But now that I have spent the last 3 weeks learning and seeing environmental problems and pluses, I want to be the type of person that gets something done for the environment."

"My goal is to collect as much information as possible about our environment and then go home and put some plans in effect. It seems like anything I do doesn't make a difference but if I can get people in my town to start recycling then in the long run, it will make a big difference."

"The summer academy was something that I am really glad I did. I learned a lot and am very excited about starting programs in my new school and my own community."

"Since I want to start an Environmental Club at my school, I got great ideas from the displays, especially the household plastic use."

"I got some more ideas for starting an Environmental Club at my school! It surprises me that every speaker or activity that I do-- I learn so much more!"

"I can't wait till school starts!...I have decided that I am going to definitely start paper recycling at my school. I made my decision after seeing the recycling plant and the landfill after seeing all of that paper in both places it is amazing how much paper it is."

"I am going to become more environmentally aware and do everything that I can. I think (I know) that this academy has helped me in doing so. Before I came, I wasn't thinking of becoming anything in the environmental jobs. But now I think that is what I am going to do."

"It made me seem so little on this huge mountain yet so very very important to the future of the mountain and its surroundings."

"Really, these four days have shown me that if I have a spark inside of me, then I can pass that onto someone else where it will ignite and burn brightly."

"These talks, questions, comments, and other thoughts stirred up motivation inside to keep trying to understand reasons for taking care of our world, proving ourselves, and taking on challenge."

"I hope everyone else is getting as much out of this academy as I am, because I've learned so much about the person I want to become and my part that I should play in taking care of our natural resources and our Earth."

"Just a thought....Let's get serious for awhile. I really am not sure what is going to happen to our Earth. I am going to hate to see what it looks like in 10 to 20 years. My future, kid's future, and grand children's future are in danger. I read and hear about all this threat of pollution and animals dying. I wonder how we are going to survive. The landfills are filling up, pollution is increasing because of the pollution expanding, the toxic waste being dumped into major city drinking water systems, and the list goes on just like the Energizer bunny. The environment just like murder is killing humans off this earth. The environment is just as important. If we're killing the environment, we're just killing ourselves."

"I realized earth's wonder at "my" place on the rock today. I could have sat there forever. My senses were so full of nature that I did not feel the hunger or thirst I felt before. I could have died, or been killed right there and I would consider it a blessing. My soul was complete at that place; I was the earth.--I AM the earth."

VITA

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Candidate for the Degree of

Master of Science

Thesis: EFFECTS OF ENVIRONMENTAL EDUCATION ON SELF-CONCEPT AND ENVIRONMENTAL RESPONSIBILITY

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