THE EXTENT AND NATURE OF AFFECTIVE AND COGNITIVE CHANGES IN TEACHERS AND STUDENTS AS THE RESULT OF PARTICIPATION IN AN ENVIRONMENTAL EDUCATION PROGRAM

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

"The current environmental crisis places environmental education as one of the top priorities in education today" (Leith and Butts, 1974:1). Educators are being asked to evaluate their curricula and redesign existing programs to aid in the development of citizens who are knowledgeable about the environment and its associated problems and who are motivated to participate in environmental problem solving (Swan, 1969).

This study is an assessment of the affective and cognitive growth of teachers who were involved in an environmental education curriculum project and the growth of their students. The literature reviewed in subsequent sections of this dissertation supports the need to develop both the affective and cognitive dimensions of individuals in environmental education programs. This study employed both affective and cognitive measures to determine the effect of an environmental education program on teachers and students. The teachers were involved in a project designed to diffuse and implement those portions of national curriculum projects in science and social studies relevant to an environmental education program. The rationale, materials and methods of these projects were introduced to the teachers for the purpose of inclusion in an existing curriculum.

Background

There is general public concern about the environment and the problems of pollution, over-population and the destruction of our natural environment. This concern and awareness of the need to conserve non-renewable natural resources have caused citizens to charge state and federal agencies and educational institutions with the responsibility for preparing citizens who are socially responsible with regard to environmental issues.

The response to this need has been varied. The Congress has enacted the Environmental Education Act (PL 91-516) and the Office of Environmental Education of the United States Office of Education has been established. The National Science Foundation has funded curriculum projects with major objectives for the improvement of environmental education (National Science Foundation, 1974). The educational agencies and institutions of several states have initiated curriculum projects.

The inclusion of environmental education in the public school curriculum has presented many problems. As with several recent national and state-wide programs which have received extensive emphasis (i.e., drug education, career education and consumer education) environmental education cuts across traditional subject areas. Dr. John Cairns, Jr., in an address to an environmental education conference stated the problem succinctly:

> . . . we must stop compartmenting (sic) everything within disciplinary boundaries. Environmental problems don't act that way! Every one transcends disciplinary boundaries! Think of it; try to identify one environmental problem that can be solved by a single discipline (Teates, 1971).

The several agencies charged with providing leadership in environmental education are in disagreement as to the methods and materials needed to affect a solution. The Environmental Protection Agency holds the position that the educational establishment should concern itself with the teaching of facts on pollution and should not be concerned with the affective implications of the problem (Environmental Protection Agency, 1974). A position paper drafted by the Virginia Science Supervisors Association (1972) perhaps best exemplifies the position taken by educators across the nation. This paper states that there should not be a subject area labeled "environmental education" and that the subject should be presented within and among the various disciplines currently taught in elementary and secondary schools. This paper stresses the importance of the affective as well as the cognitive aspects of environmental education necessary if the schools are to produce "environmentally literate individuals."

Environmental Education - Changing Definitions

There are almost as many definitions of environmental education as there are studies associated with the subject. The terms conservation education, outdoor education and environmental education are often interchanged and misused.

Conservation education was the earliest attempt to solve some of the environmental problems of the 1930's and dealt with conservation of natural resources. It was characterized by nature study activities and was centered primarily in the natural sciences. There was little

or no attempt to include social and urban problems in these curricula and projects.

Outdoor education is often interpreted as the use of areas outside the classroom as an integral part of the learning environment. Those things that are best taught in the classroom are taught indoors and those things that can best be taught in a natural environment are taught outdoors. This use of the areas around the school as a learning environment was used primarily in nature study activities and was again centered in the natural environment. Few of the materials and books used in outdoor education projects were designed for the humanities or social sciences.

Environmental education includes most of the aspects of conservation and outdoor education listed above, but it also includes activities in the social sciences, the humanities and the arts. The urban environment and its associated problems are included whereas conservation and outdoor education were usually limited to rural subject matter and schools which had open areas available for nature study. Environmental education focuses are on man and his relationship to his environments (Vivian, 1973). The affective aspects of the environment receive equal emphasis and are deemed necessary if "environmentally aware" individuals are the desired products of a program.

The Virginia State Department of Education (1974) in its "Environmental Education Guide" listed several characteristics of an

environmental education program. These characteristics may be described as:

Being interdisciplinary in nature.
Being activity centered.
Promoting interest in, awareness of and sensitivity toward the environment.
Being participant centered.
Having a future orientation.
Building toward a universal view of the environment.
Being locally developed.

There is no one curriculum project which meets all of the above listed characteristics. A large number of curriculum programs have been developed since the late 1950's in the sciences and social sciences which are inquiry or discovery oriented and participant centered. These programs, however, are neither interdisciplinary nor developed specifically to meet local needs. These national curriculum projects do contain materials which should effectively increase the impact of a locally developed environmental education program (Teates, 1973).

Prince William County (Virginia) Environmental Project

Considering the value of these national programs and their applicability to an environmental education program, application was made by Virginia Polytechnic Institute and State University and the Prince William County, Virginia, school system, to the National Science Foundation for funding for an environmental educational project. The purpose of this project was to implement and diffuse appropriate portions of national curriculum projects into the curriculum in grades one through eight of the Prince William County, Virginia, schools.

This project, funded by the National Science Foundation, provided:

> . . . special training for school personnel including a summer institute for sixty teachers, academic year institute for teachers and administrators and consultant help as needed. University personnel worked with county supervisory personnel in selected clusters of schools for the purpose of ensuring the dissemination and implementation of project activities.
>
> Content, pedagogical information and classroom experiences for elementary and middle school teachers were included in the project through the summer institute and inservice courses. Concentrated one-credit mini-courses aimed at selected science and social science topics were used to present essential content oriented experiences during the academic year. Biweekly graduate seminars were used throughout the academic year to demonstrate and permit teacher trial of appropriate instructional materials from several national curriculum projects (Teates, 1973).

PROBLEM

This study was a partial evaluation of a National Science Foundation project in Prince William County, Virginia. Specifically this study investigated the effect of participation in the project on students' and teachers' attitudes toward and knowledge of the environment and environmental problems.

Significance of the Problem

It was hoped the results of this study would indicate student benefits as a result of their teachers having been involved in the project. In addition it was hoped that findings of the study would help to (1) validate the effectiveness of a particular teacher inservice program, (2) give credibility to the inservice program designed

as a model for utilization by other school divisions, (3) serve as a formative evaluation for the improvement of environmental education inservice, (4) provide decision makers a rationale for funding similar programs.

Assumptions

A basic assumption in this study was that participation by teachers in a project designed as a materials and methods type of program would affect teacher attitudes and levels of cognition.

A limited number of teachers in a given school were treated; therefore, a second assumption of the study was that teachers in a given grade level or in a particular school interacted and worked together to a degree great enough to affect the attitudes and knowledge level of all the teachers in the schools of the participating teachers.

Limitations

This study was undertaken and completed with several constraints and limitations.

First, the participating teachers were given workshops in the general area of environmental education; no specific program was given or developed for use in the participating schools. Selection of instruments was based on the need to measure general attitudes toward and knowledge about the environment, rather than for the measurement of specific objectives or specific content areas.

Second, the project was conducted over a one year period, consisting of a summer institute and academic year seminars. The teachers received a stipend from the county in addition to graduate credit from the university during the summer session. During the academic year portion of the project the teachers received graduate credit. This and other factors such as previous commitments during the academic year, concurrent curriculum projects, and personal problems contributed to a decrease in the number of teachers enrolling during the academic year.

Third, there was little or no control over the instructional methods the teachers were to implement with their students. The minimum requirement was the use of at least three student activities during the academic year. The teachers were required to complete at least one activity with their students during each quarter of the academic year as a part of the seminars.

The fourth limitation concerned the testing program associated with this study. The participation of teachers and students from the treatment groups and the control group was on a voluntary basis. The principals of the schools involved in the testing were asked to have teachers in their schools who were not participating in the program take part in the testing program. The teachers were told the results would be kept confidential and that there would be no school comparisons calculated. The response was minimal; teachers did not mind having their students tested but were reluctant to be tested themselves. During the posttest period teachers whose students were tested were

asked individually by the author to complete the affective and cognitive measure. The response was much greater than the pretest response, with 68.4 percent completing both instruments. Teachers who participated in the summer session but who did not complete the academic year portion of the project were contacted by mail and asked to take the posttests; their response was less than adequate with only two of seventeen completing the two tests.

DEFINITION AND USE OF TERMS

Ability

The student's ability as used in this study refers to his score on the SRA (Science Research Associates) Short Test of Educational Ability (STEA).

Achievement

The student's achievement was the student's score on the Environmental Concerns Inventory (Kellner, 1972) for grades four to six and the score on the Environmental Opinion and Knowledge Survey (Hounshell and Liggett, 1973) for students in grade eight.

The teacher's achievement level was assessed by their score on the Environmental Science Test (Fleetwood, 1973).

Attitudes

Attitudes in this study refer to the values, feelings and opinions of the students and teachers. The attitudes of the students were their scores on the Environmental Semantic Differential (Leith,

1974) and its subscales. The teachers responded to the Environmental Attitude Inventory (Pettus, 1974) and its subscales.

Environment

The environment refers to the total area where living things interact with each other and the biophysical world.

Environmental Education

Environmental education refers to all experiences, both structured and unstructured, formal and informal, dealing with man's relationship with his natural and manmade surroundings. It is concerned with and includes the total human environment (PL 91-516).

Interdisciplinary

Interdisciplinary, multidisciplinary and transdisciplinary are terms referring to either the combining of, or the contributions from, two or more academic disciplines.

National Curriculum Projects

For the purpose of this study, national curriculum projects are those science and social science curriculum projects which either by design or implementation have received recognition by scientists, social scientists and educators as having content and pedagogical characteristics desired for the discipline.

National Science Foundation Project

The National Science Foundation project referred to in this study is the "Implementation of an Environmental Education Program in

Prince William County (Virginia) Schools" (grant number GW8691). The host institution for this project was Virginia Polytechnic Institute and State University.

Reading Comprehension

The student's reading comprehension is the student's score on the Reading Comprehension subtest of the SRA (Science Research Associates) Achievement Series, Forms C and D.

SUMMARY

The need for environmental education programs and their characteristics are documented. The impact of environmental education projects on teachers and their students needs to be assessed and these results should have implications for future programs.

Because the affective and cognitive levels of individuals affect their interaction with the environment, the effect of the environmental education program on teachers and their students for both of these characteristics were deemed to be worthy of study.

Several limitations should be considered with respect to this study: (1) the teachers were not given or developed a program for use, (2) teacher attrition during the academic year was a factor, (3) there was no control over the amount of or extent of teacher involvement with their students, (4) participation in the testing program was voluntary.

Chapter 2

REVIEW OF LITERATURE

The literature review for this study was concentrated in the areas of: the need for environmental education, attitudes and attitude measurement, environmental attitudes and environmental programs. The need for environmental programs, while not the subject for this research, gives some indication of the breadth and scope of environmental education. This breadth and scope of subject matter should be considered when environmental programs are evaluated.

The literature concerning attitudes and attitude measurement indicates the complexity of the problem of their measurement. The research that has been completed in the area of environmental attitudes deals with the attitudes of adults, college, and high school students. Very few studies are concerned with the attitudes of elementary pupils toward the environment. The research on environmental programs has, for the most part, been limited to: specific two to four week instructional units, analysis of groups of students attitudes and achievement, and methods and materials designed to be used with specific programs. The effect on attitudes by the broad type of interdisciplinary approach to environmental education, while much discussed, was not the type of study previously reported in the literature.

ENVIRONMENTAL EDUCATION

The charge to education for the improvement of the environment was sounded by Senator Gaylord Nelson when he introduced legislation which later was passed into law as the Environmental Quality Act. Senator Nelson recognized that the problem of checking environmental deterioration is a behavioral one; and in the long run could best be addressed through education (Ames, 1971).

Public Law 91-516 authorized the United State Commissioner of Education to establish educational programs to encourage understandings which would enhance environmental quality and maintain ecological balance. The direction proposed for environmental education programs was outlined in the "General Provisions and Criteria for Eligibility for Funding" under the Environmental Education Act (PL 91-516).

"Environmental education is generally interdisciplinary and includes all factors relating to environmental problems, the study of manmade and natural environment and is concerned with the total human environment" (National School Public Relations Association, 1971:6).

Others have written more extensively:

> Environmental education is a process aimed at producing a citizenry that is knowledgeable concerning the total environment and the role of man, able to participate in activities for maintaining and improving the quality of the environment while meeting human needs, and motivated to do so.
>
> Its inclusion in the educational curriculum is a response to both a need for educational improvement and a need for citizens who can identify, prevent and resolve problems in the process of maintaining and creating a quality environment. Responsible citizenship is a goal of the school delegated to it by society. Environmental education can contribute in a major way to the achievement

> of this goal, not by adding a new subject to an already overcrowded curriculum, but by focusing the existing curriculum upon the immediate surrounds of the student and related human processes.
>
> Environmental education attempts to achieve this goal by developing attitudes and values. Strong, rational attitudes are essential in the development of values which will motivate action for participation in the maintenance and improvement of the total environment now and in the future (Bennett and Williams, 1972:1).

The Environmental Protection Agency stated a different view in a paper presented at the 1974 meeting of the National Association of Research in Science Teaching. The agency paper pointed out that

> . . . a new definition is needed (for environmental education) over the several already in use because present versions either overlook the corrective step or submerge the issue in terms of a 'problem solving approach.' The desired outcome of environmental education is to provide a person with the knowledge, values and skills to harmonize individual and organizational activities with the earth. The 'awareness' and 'literacy' goals currently in use do not meet the full need (Environmental Protection Agency, 1974).

Shifferd (1973) responded to the E.P.A. statement most aptly, by warning that environmental studies could be carried out in conceptual isolation, by focusing on a part of the phenomenon and failing to show the interrelated part of the "bio-social" whole. What is needed, he suggests, is the ability to generalize beyond the particular cause or causes of pollution, by integrating the social sciences and the humanities along with the natural sciences in a common attack on the improvement of the quality of man's environment.

Comparable positions have been taken by Horvat (1974), Voekler (1973), the report from the Environmental Science Conference for the State Supervisors of Science (1970), and the "Position Paper on

Environmental Education" of the Virginia Science Supervisors Association (1972). These reports and articles have supported the need for the development of values and attitudes in environmental studies. Horvat (1974:10) stated, "a common thread running through environmental education's general characteristics and proposed definitions involves the recognition that environmental education places less emphasis on imparting facts than do most traditional subjects." He believes also that the value and attitude development are integral parts of an effective environmental education program.

A report by the Virginia Science Supervisors Association (1972:2) stated, ". . . environmental education should be directed at the attitudinal development and behavior modification of the individual which will result in his knowledgeable involvement in decision making effecting the environment."

To fill the void created by the need for environmental education programs, Doran, et al. (1974) observed that a large number of programs, publications, and articles have been written about environmental problems. The authors cautioned, however, that most of these were reports of isolated attempts at environmental education or were the ideas of individuals.

Labinowich (1972) indicated similar concern. He indicated that a number of publications had been placed for use in the elementary school with little regard to reading level and that some school programs simply use unrelated outdoor and conservation activities with the terminology changed to reflect the new thinking. Labinowich, while not

stating explicitly that programs such as SCIS (Science Curriculum Improvement Study) and ESS (Elementary Science Study) should be used in an environmental program, indicated that some of their units or lessons could be effectively utilized to supplement other programs. He pointed out that these programs encompass the theories of educational psychology which must be considered in program planning and curriculum development.

The response to the need for environmental education by the several states has been varied. Trent (1973) reported thirty-one states had developed environmental education courses, syllabi, or material for use by schools in the state. Twenty-four states had adopted state plans for environmental education. Only seven states had a certifiable teaching major or minor in environmental education. Other noteworthy statistics given included the approximate percentages of teachers who had received in-service instruction in methods of teaching environmental subjects. Only four of the forty states responding indicated percentages higher than 30 percent.

ATTITUDES AND ATTITUDE MEASUREMENT

A great deal of research in the area of psychology has been completed on the nature of attitudes and behavior change. Some authors (Kreech and Cutchfield, 1948 and Chein, 1951) have stated that attitudes are multidimensional, being composed of several components, including perceptions, beliefs, and expectations with respect to social groups and a policy of orientation or a tendency to react in a certain way. Rokeach (1968) considered attitudes to be composed of attitudes toward

the object and attitudes toward a situation. He suggested that attitudes toward the object inhibits or enhances the attitude toward the situation and vice versa.

Several studies have been conducted to determine if there is a link between attitude change and cognition. Flowerman (1949) found that information which runs counter to established group norms is not likely to have much effect on the group no matter how factual or scientific the information might be. No simple correlation was found between attitudes as manifested in behavior change and rational decision making (Tittle and Hill, 1967).

If attitudes are a component of all behavior, overt or covert, and if they contribute as much or more to the determination of behavior as cognitive understanding (Remmers, 1954), then the value of attitude measurement to educators becomes all the more essential.

Davis (1964) noted that while the characteristics of attitudes and the number of definitions of attitudes are varied and plentiful, they all seem to have two factors in common:

(a) attitude is an inferred entity, something which is not measured directly but deduced from other observable data.
(b) attitudes imply some sort of tendency to act toward the object for which they are held (Davis, 1964).

The tendency to act implies that the attitude can be measured by recording some overt response, an opinion, either by means of a paper and pencil or verbal response.

The history of attitude measurement began about 1928 with the work of Thurstone and has been significantly affected by the contribution, of Likert, Guttman and Osgood (Pearl, 1974). In the early work of

Thurstone, subjects reacted to a continuum of statements. Likert and others developed and refined a comulative scale in which subjects respond to all items.

Shaw and Wright (1967) succinctly characterized attitude measurement as an assessment of an individual's response to an attitude object. This response is assigned a value, called an item score, and the total derived from the item scores represents the individual's position on the attitude variable.

The semantic differential is a method of observing and measuring the psychological meaning of things, usually concepts. It assumes that although everyone sees things differently, there is a common meaning in all concepts (Osgood, et al., 1957). The technique uses a number of seven point rating scales with each extreme described by one of a set of bipolar adjectives. The participant is given a set of the scales and asked to rate each of a number of concepts on every scale in order. It is possible to submit these ratings to factor analysis. Osgood has identified the importance of three scales: evaluative, potency, and activity, in measuring meaning. The technique may be used to compare groups of respondents, if one is willing to average sets of ratings (Oppneheim, 1966).

"Relative to other scales, the attributes of the semantic differential appear acceptable" (Shaw and Wright, 1967). These same authors quote studies by Osgood, et al. (1957) in which evidence of validity is established by correlation with other scales. Correlations with Thurstone scales range from .74 to .82; one study indicated a .79 correlation with a Guttman scale.

A recent study (Young, 1974) investigated the relationship of the Purdue Master Attitude Test with a previously administered semantic differential. Both instruments were administered to 274 general physical science students at the State University of New York at Buffalo. Using the analysis of covariance ($\alpha = .05$) Young concluded that the Purdue test and the semantic differential test appear equally effective as predictors of attitude change.

McCallon and Brown (1971) correlated a semantic differential, as a measure of attitudes towards math in a doctoral level statistics class with a Likert-type instrument. The correlation established was .90. It was concluded that the semantic differential constructed for the study was as effective as the Likert-type instrument.

The use of the semantic differential with children, grades two through seven, was investigated by DiVesta (1966). The studies were conducted to determine the development of elementary students affective meaning systems. Standard deviation ratings for twenty concepts in one study and one hundred concepts in two other studies were acquired. The data were analyzed by factor analysis and evidence was found for the stability of Osgood's three principle factors, even in the second grade.

The literature contains several cases in which a semantic differential was used effectively in science research studies and/or with elementary age students. For example, Jenkins (1971) assessed specific attitudes of pupils and teachers toward elementary school science programs. Scharf (1971) used a semantic differential with fourth, fifth and sixth grade students to assess attitudes toward

mathematics. Chi square analyses were used and significant results reported for about one-half of the factors.

Numerous studies were found in which color slides or black and white pictures were used in place of the usual verbal concepts in semantic differentials. Three of these studies, Eastman (1973), DeLucia and Parker (1974) and Leith (1974) used this pictorial stimulus approach in studies dealing with attitudes toward the environment. These studies are reported in the next section of this chapter.

ATTITUDES AND ENVIRONMENTAL EDUCATION

Numerous studies have been conducted concerning the need to include methods and materials leading to attitude changes concerning the environment. According to Lucas (1972), most environmental education programs can be categorized as education "about the environment" in the hope that education "for the preservation and improvement of the environment" is taking place.

Most educators and researchers agree with Knapp (1972) in his assessment of the need to identify attitudes. If environmental education is to be concerned with changing attitudes, then the students attitudes must be identified so that the curriculum can be planned relative to each type of attitude. The results of research on attitudes about environmental issues is inconclusive and limited. Educators need to study methods which have been used to change attitudes in other areas.

There have been many studies concerning environmental attitudes. Bart (1972) constructed a hierarchy of attitudes toward the environment from an empirical study using a sample of graduate students at the

University of Minnesota. The usefulness of such a hierarchy lies in the ability to determine what environmental attitudes need to be changed in order for a specific environmental attitude to be produced. Bart also found that private attitudes tend to be independent of public attitudes and contended that the schools may have to develop programs to meet these two perceptions.

Two studies by Hoover and Schultz dealt with conservation attitudes of college students. Hoover and Schultz (1963a), used a 32 item Likert scale with science and non-science majors, identified a number of factors relating to an individual's attitude toward conservation. Many of these factors were not related to conservation problems but seemed to be linked to beliefs such as individual liberties and democratic principles. This tendency, while more evident for non-science majors, suggested to the authors that ". . . an individual is not likely to develop conservation prone attitudes through a mere study of the aforementioned (forest and wildlife conservation) aspects of the problem. Attitudes toward conservation are closely tied to broader cultural beliefs" (Hoover and Schultz, 1963a:58).

In their second study (Hoover and Schultz, 1963b) the authors used the factors identified in the first study and constructed a 116 item Likert scale with 10 to 13 items relating to the ten factors identified in the previous study. Using a cluster analysis technique three clusters were identified with Kuder-Richardson reliability coefficients greater than .70. While the three clusters do not include all concepts considered in the subject of conservation, they provide

a set of measures which probably account for a large amount of the variance associated with "conservation attitude."

Hoover and Schultz concluded that "instead of emphasizing 'facts' of conservation the science teacher might spend their instructional time more appropriately by attempting to alter basic values associated with conservation" (Hoover and Schultz, 1963b:68). The author considered these basic values, as measured in their study, to be in three areas: the "assistance for the common good," private rights versus conservation and the need for regulation .

Three studies utilized semantic differential instruments for which students were asked to respond to color transparencies related to to environmental concepts rather than to the more traditional verbal concepts. DeLucia and Parker (1974) tested 195 students in a high school biology course in which the students viewed seven slides and rated each slide on a five point differential using sixteen bipolar adjective pairs. Factor analysis of the data isolated twenty-two factors for the seven slides. The group was divided and sixty-eight students were given a two month unit dealing with environmental science. The control group, while enrolled in a biology class, did not participate in this unit until after testing. After analysis of covariance three of the identified factors indicated a significant difference ($\alpha = .01$). Three factors were identified by adjective pairs as relating to interest and awareness.

Leith (1974), using a semantic differential with color transparancies, found significant differences between the experimental and

control groups on seven out of twenty-four scores (eight slides X three factors for each slide). The differences between the experimental group and the control group were greater in only three of the seven cases. It was suggested that this limited change might have been due to the short time span between pre- and posttesting.

An evaluation of two methods of teaching an anti-litter unit utilized a similar semantic differential in a study by Eastman (1973). Eastman developed a semantic differential using thirteen concepts and seventeen color slides. This attitude measure was pilot tested with a sample of students and the content validity established by two judges. Product moment reliability coefficients were computed for the evaluative, potency, and activity factors. As with other similar studies, these coefficients ranged from .8 to .6 with the evaluative scale being the highest. The instrument was used to assess changes in attitudes that may have occurred when two methods of teaching litter were compared. No significant differences were detected between the two groups.

In the following studies the subject of attitudes toward the environment were treated. Mortensen (1972) used three methods of attitude assessment, a Likert scale, a two-part semantic differential, and unstructured responses to pictorial stimuli. The variables were analyzed using data concerning the students' socioeconomic status, place of residence, and sex. Significant differences were found on some of the different instruments but none of the results were conclusive across scales.

Steiner (1973) used factor analysis of a Likert scale to study the attitudes of Oregon high school seniors toward some environmentally-

oriented science-related social issues. An instrument of one hundred Likert items selected from a pool of two hundred and fifty were administered to high school seniors with seven factors extracted and analyzed. The characteristics of number of science courses taken, school environment (urban, rural, suburban) and sex were used as independent variables in an analysis of variance. The author was most interested in the differences in responses of science students when compared to the responses of non-science students. Although seniors with a maximum amount of science background scored significantly higher on two of the scales; there were four scales where there were no differences. Steiner concluded that attitudes are formed both inside and outside of the science classroom.

Other studies have been concerned with the effectiveness of an environmental education program with regard to attitudes and achievement. Studies by Bennett (1973) and Howell (1973) found no significant differences in attitude and achievement when environmental programs were used. Both of these studies utilized short (two to four week) environmental units as treatments.

Wievel, Hounshell and Liggett were concerned with the relationship between attitude achievement and various other variables such as sex, grade level, and place of residence (urban, suburban, and rural). Wievel (1947) found, in an Iowa study, that significant differences existed between grade levels (seniors higher) for attitudes toward conservation. He also found significant differences between grade levels in achievement on one achievement measure, soil conservation.

Wievel also found achievement linked to such variables as courses in agriculture and participation in conservation activities. Attitudes were related to number of conservation and agriculture courses taken by the instructor. These relationships, however, were not significant. Hounshell and Liggett (1972), in a study concerned with an assessment of knowledge about the environment and attitudes toward the environment by elementary students, found significant differences in attitude (females scoring higher) and achievement (urban higher than rural). Both of these findings were based on surveys of students in general and not a treatment-control group comparison.

There have been many studies conducted in recent years concerning environmental programs, methods of instruction and attitudes. Studies by Howie (1972) and DeBanc (1973) were concerned with the effectiveness of outdoor programs in regard to environmental education. Both studies compared the achievement of students receiving outdoor instruction in addition to classroom instruction, with those receiving classroom instuction only. In each case those students receiving the outdoor experience achieved significantly higher than those who did not (the classroom group). Howie (1972) also tested a group that received outdoor instruction only. While this group achieved significantly higher than the classroom group, it did not achieve higher than the outdoor plus classroom group.

Laug (1970) used an attitude questionnaire, designed for the study, to determine if attitudinal changes could be achieved when an experimental group was exposed to "practical" conservation activities.

College freshmen were randomly assigned to experimental and control groups. After the experimental group received two weeks of instruction, the two groups were posttested. The treatment group exhibited significantly higher results.

SUMMARY

The research associated with environmental attitudes and programs can be summarized as follows:

(1) There is a need to identify attitudes pertaining to the environment.

(2) There is evidence of little or no correlation between cognitive level and attitudes.

(3) Most of the studies in the area of environmental education can be categorized as

   a. assessments of program effectiveness
   b. construction of attitude scales
   c. description of a population's attitudes.

The need for the measurement of attitudes as a separate entity is well documented. The assumption that an increase in cognition will produce a concomitant increase in positive attitudes may not be valid. There is inconclusive evidence or, at most, minimal evidence that present environmental programs are successful in changing attitudes in a positive or desired sense. This may be in part due to the insensitivity of the instrumentation or the minimal time span between measurements.

There is a concern that some of the materials produced in recent years for students in the area of environmental education pay too little attention to the students' characteristics at the various grade levels.

The use of instructional materials from national curriculum projects which were designed with the students' reading levels and conceptual abilities being considered seems to be a way of avoiding this problem.

Chapter 3

MATERIALS AND METHODS

After surveying the literature and considering the objectives of the National Science Foundation project there are several questions that are germane to this study.

It is reasonable to expect an attitude change with regard to the environment and environmental problems when teachers are exposed to an environmental education program? By selecting representative teachers from a school to participate in the project, can one expect these teachers to provide sufficient leadership in their schools to affect other teachers' attitudes? By treating the teachers is it possible to have an impact on their students as indicated by a more favorable attitude toward the environment? Is there a sufficient interaction between teachers in a school to contribute to an improvement in the attitudes of students of non-participating teachers in a target school?

In the area of cognitive growth the same questions can be asked. Can the teachers cognitive level be raised and is there a "carry over" to their students, to other teachers in the school, and to other students in their school? Do selected student characteristics such as reading level, ability level, science background, math achievement, and social studies achievement influence the students' affective and cognitive levels?

Three groups of teachers and students were used in this study. These groups are designated as follows:

Teachers Group
- T_1 - Teachers who participated in the environmental education project.
- T_2 - Teachers who did not participate in the project but who taught in the same school as T_1 teachers.
- T_3 - Teachers who did not participate in the project and who did not teach in the same school as teachers who participated.

Students Group
- S_1 - Students who had at least one of their teachers enrolled in the project.
- S_2 - Students in the same school as S_1 students but whose teachers were not enrolled in the project.
- S_3 - Students whose teachers were not associated with the project or with teachers associated with the project.

With the aforementioned questions in mind, the following research hypotheses were generated to be tested by this study.

1. There is a difference in the adjusted mean achievement scores of teachers when the following groups are compared: Group T_1 with T_3, T_2 with T_3, and T_1 with T_2.

2. There is a difference in the adjusted mean attitude scores of teachers when the following groups are compared: Group T_1 with T_3, T_2 with T_3, and T_1 with T_2.

3. There is a difference in the adjusted mean achievement scores of students when the following groups are compared: Group S_1 with S_3, S_2 with S_3, and S_1 with S_2.

4. There is a difference in the adjusted mean attitude scores of students when the following groups are compared: Group S_1 with S_3, S_2 with S_3 and S_1 with S_2.

POPULATION

Teachers

The population of teachers for this study included teachers from the elementary and middle schools of Prince William County, Virginia. This population included approximately 1185 teachers from 28 elementary schools and 10 middle schools. The sample derived from this population included teachers from kindergarten through fifth grade from seventeen elementary schools and sixth through eighth grade teachers from seven middle schools.

The principals of five elementary schools from the project and five elementary schools not involved in the project were asked to request three to five members of their faculties to take the environmental knowledge test and the environmental attitude survey. During the post-test period the author asked teachers whose students were tested to complete the same two instruments. Table 1 summarizes the number of teachers tested.

Sixteen of the treatment teachers did not complete the program and did not respond to the request to complete the posttesting. Seven teachers were added to the project after the summer session. These teachers did not complete the pre-tests. Two of the three second treatment group teachers left the county prior to the posttesting and

Table 1

Sample of Teachers Tested

	Group T_1	Group T_2	Group T_3	Total
Teachers Pre-Tested	49	14	13	76
Teachers Post Tested	40	35	54	129
Teachers Pre- and Posttested	33	11	8	52

were, therefore, not available for testing. One teacher did not complete the posttest as requested. There were five control teachers who did not complete the posttests, one because she left the country and four did not return completed instruments.

Students

The population of students for this study included fourth, fifth, sixth and eighth grade students enrolled in the public schools of Prince William County, Virginia. The sample derived from this population included fourth and fifth grade students from ten elementary schools and sixth and eighth grade students from eight middle schools in the county.

Elementary. Teachers from seventeen elementary schools were enrolled in the N.S.F. project. Five of these schools were identified as treatment schools because they had fourth and fifth grade teachers

enrolled in the project. Five schools were identified as control schools and did not have teachers enrolled in the project. These control schools were chosen to match the treatment schools as to the characteristics of size and geographic area.

The principals of the five treatment schools were contacted and asked to select a random sample of approximately fifteen fourth and fifteen fifth grade students from the classrooms of teachers enrolled in the project, and select a random sample of the same size from the fourth and fifth grade teachers not enrolled. Principals of the five control schools were asked to select a sample of fifteen fourth grade students and fifteen fifth grade students. These principals were given suggestions as to several methods which could be used to achieve a random sample and all indicated they would use one of the methods suggested.

Middle. Six of the ten middle schools in the county were involved in the project. Two middle schools in the county were involved in a 45-15 year round plan and were eliminated from the study. The two middle schools not participating in the project were identified as control schools for the study. Four of the six schools had sixth grade teachers involved and five had eighth grade teachers enrolled. The principals of these schools and the control schools were asked to randomly select students in the same manner as the elementary principals. Suggestions were given as to methods that could be employed to receive a random sample and the principals agreet to attempt to provide a

random sample. Table 2 gives the numbers of students pre- and post-tested at each grade level and in each group.

Table 2

Sample of Students

Grade	4th	5th	6th	8th	Total	Not Post Tested
S_1	56	40	71	72	239	41
S_2	25	42	49	56	173	28
S_3	68	65	70	56	259	34
Total	149	148	190	184	671	103
Not Post Tested	17	12	33	41	103	

One hundred and three students were not posttested, this represented 13.3 percent of the total sample. These 103 students were not posttested because 68 students left the school or county during the treatment period and 35 students were absent on the posttest date. The number of schools involved and time constraints prevented follow-up testing of these students.

Appendix A contains ability and achievement data for the students' characteristics. These data included information as to the student's mean scores on the SRA Achievement Test Series. The treatment students' scores were consistantly higher than the other two groups. Subsequent analysis of the data considered these differences.

INSTRUMENTATION

Teachers

The teachers were pre- and posttested using an environmental knowledge test and an environmental attitude measure. These instruments, both of which have subscales, were administered to determine the extent and nature of changes in the teachers' attitudes toward and knowledge about the environment.

Environmental Cognitive Measure

The Environmental Science Test (Fleetwood, 1973) was chosen as a measure of teacher knowledge. This test was developed for tenth grade students to measure their general knowledge about the environment and environmental problems and consists of four subscales: Ecosystems, Natural Resources, Pollution and Environmental Decision Making. The author reports that these scales are composed of questions from the knowledge level and from the higher intellectual abilities and skills levels of the cognitive domain.

The test was validated by a panel of judges drawn from the scientific and educational fields and by test analysis procedures. Tests of internal reliability were reported as a Kuder-Richardson formula 20 coefficient of .91 and a test/retest coefficient of .93. The standard error or measurement was calculated as less than 4.0 raw score points.

Environmental Attitude Measure

The Environmental Attitude Inventory (Pettus, 1974) was selected as a measure of teacher attitudes because it was developed using a sample of Virginia teachers and it yielded subscores which would aid in the assessment of the nature of affective changes.

The three scales in addition to a total score that the instrument was designed to yield are: The Need for Responsible Action, The Need to Prepare for the Future, and the Need for Policies and Controls to Prevent Environmental Pollution and Degradation.

The validity of the instrument was established by the use of a panel of judges. Reliability coefficients were reported for the inventory and the subscales. The Kuder-Richardson formula 20 reliability estimates were reported as .835 for the inventory and .771, .580 and .655 for scales I, II, and III respectively.

Students

All students were pre-tested and posttested by the researcher using a semantic differential and an environmental knowledge test. Data on the students' abilities, reading comprehension, science knowledge, math skills, and social studies achievement were obtained from SRA Achievement Series and the STEA test which are administered as a part of the state testing program. The instruments used in this study were employed for two purposes, to measure attitude changes with respect to the environment and to measure cognitive changes which occurred in the students as a result of their teachers being involved in the study.

The eighth grade students were tested for knowledge using the Environmental Knowledge and Opinion Survey in place of the Environmental Concerns Inventory used for the fourth, fifth and sixth grade students. A sample of eighth grade students in the county were administered the Environmental Concerns Inventory. The mean score of the students (18.7 out of 23 possible) indicated the test would not discriminate for this grade level. The Environmental Knowledge and Opinion Survey was, therefore, used only for the eighth grade students.

Environmental Attitude Measure

The semantic differential was chosen as a measure of attitude because it placed minimal emphasis on reading and writing. The literature reviewed for this study gave numerous examples of the use of the semantic differential as a measure of attitudes. The substitution of color slides for the more traditional single word or short sentence criterion concepts seemed appropriate for elementary students as it reduced the emphasis on reading.

Eight slides were used in the Environmental Semantic Differential; six of these slides were used in a previous study (Leith, 1974). Two of her slides were replaced, one because it resulted in a low discrimination in her study and the other because it seemed appropriate for students in a specific region only. Descriptions of the slides are given below:

Slide #1 - Several ducks swimming in a running, relatively unpolluted stream.*

Slide #2 - A crowd of interracially mixed smiling children, fairly well dressed.*

Slide #3 - A silhouette of a tree against the background of a beautiful sunset.

Slide #4 - Ducks feeding in the grass at the edge of a pond or lake which contains some trash and debris.*

Slide #5 - A meadow scene showing a close-up of some wild flowers and grasses.*

Slide #6 - A collection of overflowing garbage cans along a brick wall. Sign above trash says "Please Put Trash in Cans."*

Slide #7 - A beach scene showing a very overcrowded beach.*

Slide #8 - A scene of a fast flowing river over some rapids.

Each slide was accompanied by the same twelve pairs of polar adjectives (Table 3). The students responded on a seven-point scale valued from seven to one for each adjective pair for each slide. Subscores were computed for each of the three factors, evaluative, potency and activity for each slide.

These three subscales were identified by Osgood, et al. (1957) from a factor analysis of polar adjective pairs. Leigh (1974) subjected the twelve pairs of adjective pairs, used in her study to a factor analysis. The resulting factor loadings are listed in Table 3. The factor loadings for the evaluative factor show much greater strength, 0.88 to 0.79 than do those for activity, 0.70 to 0.46, and potency, 0.62 to 0.44.

Reliabilities computed on the Environmental Semantic Differential reported by Leith (1974) show significant reliabilities of 0.61 for the evaluative factor (r significant at .01 level) and 0.41 for the potency

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*from Leith (1974).

Table 3

Osgood's List of Polar Adjectives and Extracted Factor Loadings

Polar Adjectives	Factors	Extracted Factor Loadings
Good-Bad	Evaluative	0.88
Small-Large	Potency	0.62
Fast-Slow	Activity	0.70
Unpleasant-Pleasant	Evaluative	0.82
Strong-Weak	Potency	0.62
Quiet-Active	Activity	0.59
Clean-Dirty	Evaluative	0.82
Light-Heavy	Potency	0.62
Hot-Cold	Activity	0.46
Worthless-Valuable	Evaluative	0.79
Soft-Hard	Potency	0.44
Dull-Sharp	Activity	0.52

(Leith, 1974:44)

factor (r significant at .05 level). The reliability of the activity factor was not significant. The validity of the semantic differential from the Leith study was based on the selection of slides that reflected environmental problem situations and the use of already validated word pairs. The slides selected for this study included six previously used by Leith (1974) with the addition of a slide for the aesthetic dimension of the environment and one dealing with water. The Environmental Semantic Differential and instructions for its administration are provided in Appendix B.

Environmental Knowledge Measures, Grades Four, Five and Six

This instrument was developed by Kellner (1972) for use with an environmental education program in Wisconsin supported by Title III of Elementary and Secondary Education Act. Its purpose was to measure the change in students' achievement after they had experienced an environmental education program.

This test, which was designed for use with fifth to seventh grade students, consists of responding to twenty-three environmental problem situations. The students select the most correct answer from a number of possible solutions. The items are scored right or wrong and then summed for a total score.

The literature contained little data on the reliability or validity of this instrument. The inventory was used by Leith (1974) who conducted a reliability study using thirty-one fourth grade students over a test/retest period of one month. A Pearson Product Moment Correlation was computed and the resultant coefficient of 0.63

was significant at the .01 level. Content validity was assumed based on the nature of the environmentally related problem situations presented by the instrument.

Environmental Knowledge Measure, Grade Eight

The Environmental Knowledge and Opinion Survey (Hounshell and Liggett, 1973) was administered to eighth grade students as a measure of environmental knowledge. This test was developed for use with a Title III, E.S.E.A. grant as an evaluation instrument. The test was designed to be used with sixth grade students and is a shorter version of a sixty-five item test originally developed. The test has a knowledge scale composed of twenty-five items and an opinion scale composed of the same number of items.

The authors reported that the test was submitted to a panel of judges from both the scientific and educational fields. A reliability estimate was not reported in the literature. The Kuder-Richardson Formula 20 reliability coefficient for the eighth grade students tested in this study was .767 for the pre-test and .794 for the posttest.

Measure of Student Characteristics

Variables other than the pre- and posttest score on the previously mentioned tests of interest in this study were the students' reading comprehension and their scores on the science, social studies, and math tests of the SRA Achievement Series. These data were used in a regression analysis to determine which scores, if any, should be used to adjust the mean knowledge and attitude scores.

The tests were administered by the county as a part of the statewide testing program. The scores were reported as an SRA growth scale which is an adjusted score to enable comparisons between forms and between years. All fifth grade students completed the test battery in the fall of 1973 and thr fourth and sixth grade students were tested in the fall of 1974.

The authors report that the tests were constructed to measure those aspects of the curriculum customarily found in the elementary and junior high schools. Kuder-Richardson Formula 20 coefficients for these tests ranged from .79 to .88 depending on the form and subtest (Thorpe et al., 1972).

Measure of Student Ability Level

This test is a short, easy to administer 'ability' test administered to the students as a part of the SRA testing program. The items are drawn from the longer SRA Test of Educational Abilities. The authors admit that not all dimensions of 'ability' are measured but they report adequate correlations with the long form. Predictive validity information unique to the short form is not available. The authors report correlations with the Test of Educational Abilities between .54 and .80 for the fourth grade and .80 to .82 for the sixth grade. The reliabilities reported range from .88 to .90 for the fourth grade and were .91 for the sixth grade. Both split half and Kuder-Richardson formula 20 calculations were used to obtain these coefficients (Science Research Associates, 1969).

TREATMENTS

In this study the treatment was applied to teachers; there was no direct contact by the project personnel with students. Two groups of individuals were previously referred to in this study as treatment groups. The first group, designated group T_1, is composed of teachers who were enrolled in the National Science Foundation Project. The students of these teachers were regarded as group S_1 when tests on student data were analyzed. Since students could have more than one teacher, the criterion for their placement in this group was that at least one of their teachers were participating in the project. The second group (referred to as group T_2) was composed of teachers in the same school as T_1 teachers but who did not directly participate in the project. The S_2 students were the students of teachers who were classified in this manner. Control teachers (T_3) were those teachers who taught in schools not associated with the project. Their students were classified as control students (S_3).

Groups T_1 and S_1

These teachers participated in the NSF project "Implementation of an Environmental Education Program in Prince William County (Virginia) Schools." This project included materials and methods type seminars and subject matter courses during the summer and academic year 1974-75.

The materials and methods seminars included work in the interdisciplinary nature of environmental education, the use of the outdoors as an extension of the classroom, and the need to develop attitudes as

a part of an environmental education program. In addition, the teachers were introduced to the rationale, materials and methodology used in some of the national curriculum projects in science and social studies. Some of the projects selected for use in these seminars included, the Science Curriculum Improvement Study, Elementary Science Study, Environmental Studies, Man a Course of Study, and the High School Geography Project. Materials were also examined from Man in the Environment and the Geography of the Cities programs.

Most of these programs have material that could be directly implemented at the appropriate grade levels in the county because they were designed for use in the elementary and middle school grades. Other programs were used for instructional purposes or were used to indicate alternative methods of instruction that could be used as models but not implemented as they were not specifically designed for the grade levels designated for the project.

The subject matter courses werw short (1 quarter hour graduate credit) courses concentrated on a particular phase of an area identified by county personnel as areas teachers would find beneficial for the improvement of their present program. These courses were in the areas of water resources, cities, technology, mapping, and a course labeled "Americana" which was centered in rural skills and technology.

The students of these teachers were identified as members of group S_1.

Groups T_2 and S_2

The second group of interest in this study was made up of teachers who were not enrolled in the project but who taught in the same schools as the participating teachers. The students of these teachers were placed in group S_2 for testing purposes. The participants, as a part of the project, were to work closely with the other teachers in their schools and at their grade level to implement the materials and methods presented during the project. It was hoped that the participants would increase the effectiveness of the program by interacting with other teachers in their respective schools. The students of these teachers were tested to determine if the desired "multiplier effect" was a reasonable expectation.

Groups T_3 and S_3

The teachers and students of school which were not involved in the project were identified and tested as a control group.

ANALYSIS OF DATA

Teachers

The teachers recorded their responses to the two test instruments on standard IBM answer sheets. The knowledge tests were scored by the V.P.I. and S.U. Learning Resource Center's Test Scoring Service. Attitude responses were punched on cards by the same service. The attitude data were recoded and scales computed using the SPSS-Version 6 (Nie, et al., 1975) computer programs.

Descriptive statistics for the continuous variables were analyzed with the SPSS procedure "condescriptive".

Analysis of covariance was used to determine differences between the adjusted posttest means of each set of the three groups. The MANOVA (Clyde, 1969) Program was used for this analysis. The same program was used for a multivariant analysis of covariance on the subscales and total attitude score.

The SPSS computer procedure "t-test" was used to determine if differences existed for each group of teachers between the pre-test and posttest.

Students

Student responses were either recorded on or transferred to IBM standard answer forms which were machine scored. The data were then punched on computer cards to facilitate the analysis.

Affective Measure

The data for the attitude measure were recoded and scales computed for each slide using the SPSS computer programs. A score was computed for each student for each of the three factors on each of the eight slides. Total scores were then computed for each of the three factors (evaluative, potency and activity) for all of the slides.

STEA scores and SRA Achievement scores were collected for each student. The SRA scores consisted of the composite score and the scores on the Reading Comprehension, Science, Math Computation and Social Studies subtests of the SRA Achievement Series. These data were used as

independent variables in a stepwise regression analysis with the total attitude score as the dependent variable to determine which score, if any, should be used as a covariate along with the pre-test score to adjust the posttest means.

A three way multivariant analysis of covariance was then computed using the MANOVA computer program. The independent variables in this analysis were the students' grade level, group membership, and sex. The dependent variables were the students' total evaluative, potency and activity scores.

Cognitive Measure

Descriptive statistics for these data were analyzed using the SPSS computer program. A stepwise regression analysis was used to determine which of the SRA scores should be used as covariates along with the pretest data to adjust the students' cognitive scores. This analysis was also completed using an SPSS program.

The adjusted knowledge scores were used as the dependent variable in a three way analysis of covariance using the MANOVA computer program. The independent variables for this analysis were the students' grade level, group membership, and sex.

SUMMARY

The materials and methods described in this study were used to test the research hypotheses previously mentioned. Attitude and knowledge measures were administered to a sample of teachers and students representative of the three groups described. This sample was derived

from the fourth, fifth, sixth and eighth grade teachers and students from the Prince William County, Virginia, schools. The criteria for their placement in the three groups were based on the level of the teachers participation in an environmental education program, sponsored by Virginia Polytechnic Institute and State University and funded by the National Science Foundation.

The teachers were administered the Environmental Science Test as a cognitive measure and the Environmental Attitude Inventory as an affective measure.

All students completed the Environmental Semantic Differential to determine their affective level. Fourth, fifth and sixth grade students completed the Environmental Concerns Inventory as a cognitive indicator and the eighth grade students were administered the Environmental Knowledge and Opinion Survey for the same purpose. In addition to these measures, data about the students' ability levels were collected from the STEA test results. Indications of the students' background in science, math, social studies, and reading were obtained from the SRA Achievement Series administered by the county as a part of the state testing program. These data were obtained to be used as possible covariates along with the pre-test scores to adjust the pos-test means.

The data were then analyzed to detect differences in students' scores when grade level, group membership, and sex were used as independent variables.

Chapter 4

RESULTS

The teacher knowledge data, teacher attitude data, student knowledge data and student attitude data were analyzed separately. The results of these four sets of analyses are reported in the four sections of this chapter.

TEACHERS

The teacher data are reported for the pre-test group, the post-test group and the group of teachers that completed both the pre-test and the posttest. The results for the primary treatment group, the secondary treatment group and the control group are reported.

Cognitive Data

The descriptive statistics for the achievement pre-test data are reported in Table 4 which includes the number of cases, mean, standard deviation, Kuder-Richardson formula 20 reliability coefficient and the standard error of measurement for each scale and the total score. Inspection of these data indicates that the means for the primary treatment group (T_1) were lower than the means of the other two groups on each of the subscales and the total score, except for scale four.

One hundred and twenty-nine teachers completed the cognitive posttest. The means, standard deviation, K-R 20 reliability estimate and the standard error of measurement are summarized in Table 5 for

Table 4

Descriptive Statistics Cognitive Pre-Test Teacher Data

Group	T_1	T_2	T_3	Total
Number of Cases	47	14	15	76
Scale 1				
Mean	20.26	21.79	20.33	20.55
S.D.	5.034	3.405	4.011	4.618
K-R 20				.774
S.E.M.				2.195
Scale 2				
Mean	13.94	14.79	14.33	14.17
S.D.	2.621	1.567	2.749	2.510
K-R 20				.602
S.E.M.				1.584
Scale 3				
Mean	13.47	14.36	14.00	13.74
S.D.	2.624	2.379	1.789	2.462
K-R 20				.611
S.E.M.				1.536
Scale 4				
Mean	9.83	10.43	9.13	9.80
S.D.	3.171	2.412	1.784	2.842
K-R 20				.643
S.E.M.				1.700
Total Scale				
Mean	57.49	61.36	57.80	58.26
S.D.	11.596	7.413	7.432	10.31
K-R 20				.880
S.E.M.				3.567

Table 5

Descriptive Statistics Cognitive Posttest Teacher Data

Group	T_1	T_2	T_3	Total
Number of Cases	40	35	54	129
Scale 1				
Mean	21.29	19.66	18.02	19.45
S.D.	4.839	5.682	5.675	5.612
K-R 20				.842
S.E.M.				2.228
Scale 2				
Mean	15.03	13.29	13.19	13.76
S.D.	2.611	4.199	3.888	3.743
K-R 20				.837
S.E.M.				1.511
Scale 3				
Mean	13.89	13.00	12.28	12.96
S.D.	2.614	4.382	3.993	3.817
K-R 20				.837
S.E.M.				1.542
Scale 4				
Mean	10.53	9.49	8.98	9.58
S.D.	3.093	3.931	3.951	3.766
K-R 20				.808
S.E.M.				1.649
Total Scale				
Mean	60.74	55.43	52.46	55.76
S.D.	11.23	16.85	15.06	14.98
K-R 20				.943
S.E.M.				3.562

each of the scales and the total score. The means for the primary treatment group exceeded the means for the other two groups on each of the subscales and the total test score.

Fifty-two of the one hundred and twenty-nine teachers completed both the pre-test and the posttest. This sample was composed of thirty-three teachers from the first treatment group, eleven teachers from the second treatment group and eight teachers from the control group. The cognitive data for this sample of fifty-two were analyzed by an analysis of covariance to detect differences that might exist between the adjusted means of the three groups (Table 6). The results of this analysis indicated no differences existed between the three groups that could be attributed to the treatment.

The sample sizes for the second treatment group and control group were small in comparison to the first treatment group size. Because differences might exist in the treatment group, a t-test for dependent samples was calculated on the treatment group data only. The results of this analysis, as reported in Table 7, indicate no differences existed between the pre-test and the posttest. In all cases the pre-test means were higher than the posttest means for this group. The results of this test indicate that no cognitive growth occurred as a result of the treatment.

Affective Data

The descriptive statistics for the teachers' attitude data were generated using the SPSS computer program procedure "condescriptive." The results of the pre-test data are contained in Table 8. The primary

Table 6

Analysis of Covariance Teacher Cognitive Data

Source	S.S.	D.F.	M.S.	F value	Probability
Scale 1					
Between groups	22.45	2	11.23	.458	.636
Within groups	1128.	46	24.54		
Scale 2					
Between groups	17.78	2	8.89	.845	.436
Within groups	483.7	46	10.52		
Scale 3					
Between groups	12.53	2	6.26	.681	.511
Within groups	422.7	46	9.19		
Scale 4					
Between groups	4.80	2	2.40	.330	.721
Within groups	335.1	46	7.28		
Total Scale					
Between groups	93.57	2	46.79	.306	.738
Within groups	7024.	46	152.7		

n = 52

Table 7

t-test for Dependent Data - Treatment Teachers Cognitive Data

Variable	Mean	Difference Mean	t Value	Two Tail Probability
Scale 1 Pre	21.454	1.303	1.13	.266
Scale 1 Post	20.151			
Scale 2 Pre	14.545	.303	.38	.703
Scale 2 Post	14.242			
Scale 3 Pre	13.757	.576	.82	.420
Scale 3 Post	13.181			
Scale 4 Pre	10.091	.121	.20	.847
Scale 4 Post	9.970			
Total Scale Pre	59.849	2.303	.76	.452
Total Scale Post	57.545			
n = 33				

Table 8

Descriptive Statistics Affective Pre-test Teacher Data

Group	T_1	T_2	T_3	Total
Number of Cases	48	14	13	75
Scale 1				
Mean	47.52	43.57	46.23	46.57
S.D.	4.877	6.406	3.370	5.147
S.E.	.704	1.712	.935	.594
Scale 2				
Mean	18.95	19.9	19.15	19.15
S.D.	3.287	3.766	3.132	3.324
S.E.	.474	1.006	.069	.384
Scale 1				
Mean	33.95	31.43	33.62	33.43
S.D.	4.820	5.571	4.032	4.877
S.E.	.696	1.489	1.118	.563
Total Scale				
Mean	105.8	102.1	107.4	105.4
S.D.	15.51	15.99	7.113	14.45
S.E.	2.239	4.274	1.973	1.669

treatment group means did not exceed the means of the other two groups by more than 1.5 raw score points on any of the three subscales or the total score.

The descriptive statistics for the posttest data are summarized in Table 9. The means, standard deviations and standard errors of measurement are given for each of the three scales and the total scale for each of the three groups and the total group. The treatment group means are higher on all scales.

Fifty teachers completed both the attitude pre-test and the posttest. Thirty-two of these teachers were members of the treatment group. Ten and eight teachers were members of the second treatment group and the control group respectively. The data for these teachers were subjected to an analysis of covariance for each scale and the total scale using the pre-test scores to adjust the posttest scores. This analysis was completed using the MANOVA program (Clyde, 1969). The results of these tests (Table 10) indicated that there were no significant differences between the three groups when the posttest means were adjusted for the pre-test means.

t-tests for dependent samples were calculated for the sample of teachers that completed both the pre-test and posttest. The results of these t-tests, as reported in Table 11, indicate that the treatment group showed significant increases on all four scales of the attitude inventory. The total scale showed the greatest increase. This scale was not summative because three items of the inventory were used to compute the total score which were not used to calculate the other scale scores.

Table 9

Descriptive Statistics Affective Posttest Teacher Data

Group	T_1	T_2	T_3	Total
Number of Cases	40	34	53	127
Scale 1				
Mean	49.77	47.91	47.47	48.33
S.D.	4.365	4.883	5.213	4.936
S.E.	.690	.837	.716	.438
Scale 2				
Mean	20.25	19.62	19.25	19.66
S.D.	3.028	3.576	3.491	3.376
S.E.	.479	.613	.480	.300
Scale 3				
Mean	35.60	34.88	34.21	34.83
S.D.	4.217	4.395	4.307	4.310
S.E.	.667	.754	.592	.382
Total Scale				
Mean	113.5	110.1	108.3	110.4
S.D.	10.27	11.91	11.09	11.21
S.E.	1.625	2.043	1.524	.995

Table 10

Analysis of Covariance Teacher Affective Data

Source	S.S.	D.F.	M.S.	F Value	Probability
Scale 1					
Between groups	21.03	2	10.51	.839	.439
Within groups	576.6	46	12.54		
Scale 2					
Between groups	23.78	2	11.89	2.267	.115
Within groups	241.3	46	5.24		
Scale 3					
Between groups	22.76	2	11.38	1.136	.330
Within groups	460.8	46	10.02		
Total Scale					
Between groups	262.6	2	131.3	1.295	.284
Within groups	466.	46	101.4		

n = 50

Table 11

t-Test for Dependent Data - Treatment Teachers Affective Data

Variable	Mean	Difference Mean	t Value	Two Tail Probability
Scale 1 Pre	46.18	-3.242	-1.96	.054*
Scale 1 Post	49.42			
Scale 2 Pre	18.00	-2.06	-2.60	.014*
Scale 2 Post	20.06			
Scale 3 Pre	32.21	-2.848	-2.29	.029*
Scale 3 Post	35.06			
Total Scale Pre	101.2	-11.09	-2.51	.017*
Total Scale Post	112.37			
n = 32				

* significant at the .05 level.

STUDENTS

The student data were analyzed to test differences in both the cognitive and affective variables. Those students who completed both the pre-tests and the posttests were included in the analysis.

Cognitive Data

The student test data were analyzed in two groups. Students in grades four, five and six were administered the Environmental Concerns Inventory and were analyzed as one group. The eighth grade students completed the Environmental Knowledge and Opinion Survey and these data were analyzed as a second group.

Students in Grades Four, Five and Six

The cognitive test data for this group are summarized in Table 12. The number of cases, means, standard deviations, standard error or measurement, and the Kuder-Richardson formula 20 reliability coefficients are given for each test. Inspection of the means indicated that the treatment group scored higher on both the pre-test and the posttest.

Base line data were collected for all students. These data consisted of growth scores taken from the SRA Achievement Series and the STEA test scores which were administered as a part of the state testing program. Achievement scores included the SRA Composite score and test scores in reading, math, social studies and science. The STEA score was used as an indication of the students' abilities. These data are summarized in Appendix A.

Table 12

Descriptive Statistics Student Cognitive Data Grades Four, Five and Six

Test	Group	N	Mean	Standard Deviation	Standard Error of Measurement	K-R 20 Estimate
Pre	S_1	187	13.76	3.775		
	S_2	135	12.68	3.831		
	S_3	226	12.77	3.868		
	Total	548	13.08	3.858	2.093	.706
Post	S_1	169	14.79	3.983		
	S_2	117	13.33	4.391		
	S_3	203	13.67	4.113		
	Total	489	13.98	3.983	2.042	.737

A stepwise regression analysis was performed using the data to determine which scores, if any, should be used as covariates with the students' cognitive scores. The environmental knowledge posttest scores were used as the dependent variables and the six SRA scores were the independent variables. Table 13 summarizes the results of this analysis.

The SRA Reading scores were used as a covariate to adjust the knowledge scores. The SRA Reading scores accounted for 33 percent of the variance in the knowledge scores. The other five scores only accounted for an additional 4.45 percent.

The fourth, fifth and sixth grade students' cognitive scores were analyzed with an analysis of covariance. The pre-test scores and the SRA reading scores were used to adjust the means of the posttest scores. A three way analysis of covariance was used with the students grade level, group membership and sex as the independent variables and the cognitive scores as the dependent variable. The results of this analysis (Table 14) indicated that there was a significant group by grade by sex interaction and a significant group by grade interaction.

The group by grade by sex interaction is illustrated in Figure 1. Fourth grade S_2 females scored significantly higher than other fourth grade students. The greatest difference in the fourth grade students was between fourth grade females in group S_2 and fourth grade males in group S_2. However, the fifth grade scores for the S_2 male and female groups were extremely close.

The group by grade interaction (Figure 2) indicated that significant interaction was caused by the S_1 and S_3 groups scoring significantly

Table 13

Regression Analysis: Environmental Knowledge
Posttest Scores with SRA Test Scores

Variable	Multiple R	R Square	R^2 Change
SRA Reading	.5753	.3309	.3309
SRA Composite	.5842	.3413	.0103
SRA Math	.6062	.3675	.0262
SRA Social Studies	.6099	.3720	.0045
STEA	.6116	.3741	.0021
SRA Science	.6127	.3754	.0014

n = 489

Table 14

Three Way Analysis of Covariance Fourth, Fifth and Sixth Grade Student Cognitive Scores Using Pre-Test and SRA Reading Scores as Covariates

Source	S.S.	D.F.	M.S.	F Value	Probability
Group	25.17	2	12.58	1.618	.200
Grade	102.5	2	51.26	6.588	.022*
Sex	87.99	1	87.99	11.31	.001*
Group X Grade	77.23	4	19.31	2.481	.043*
Group X Sex	4.173	2	2.087	.268	.765
Grade X Sex	2.785	2	1.393	.179	.836
Group X Grade X Sex	103.8	4	25.95	3.335	.010*
Within Cells	3345.	4.30	7.781		
n = 450					

* Probability significant at .05 level.

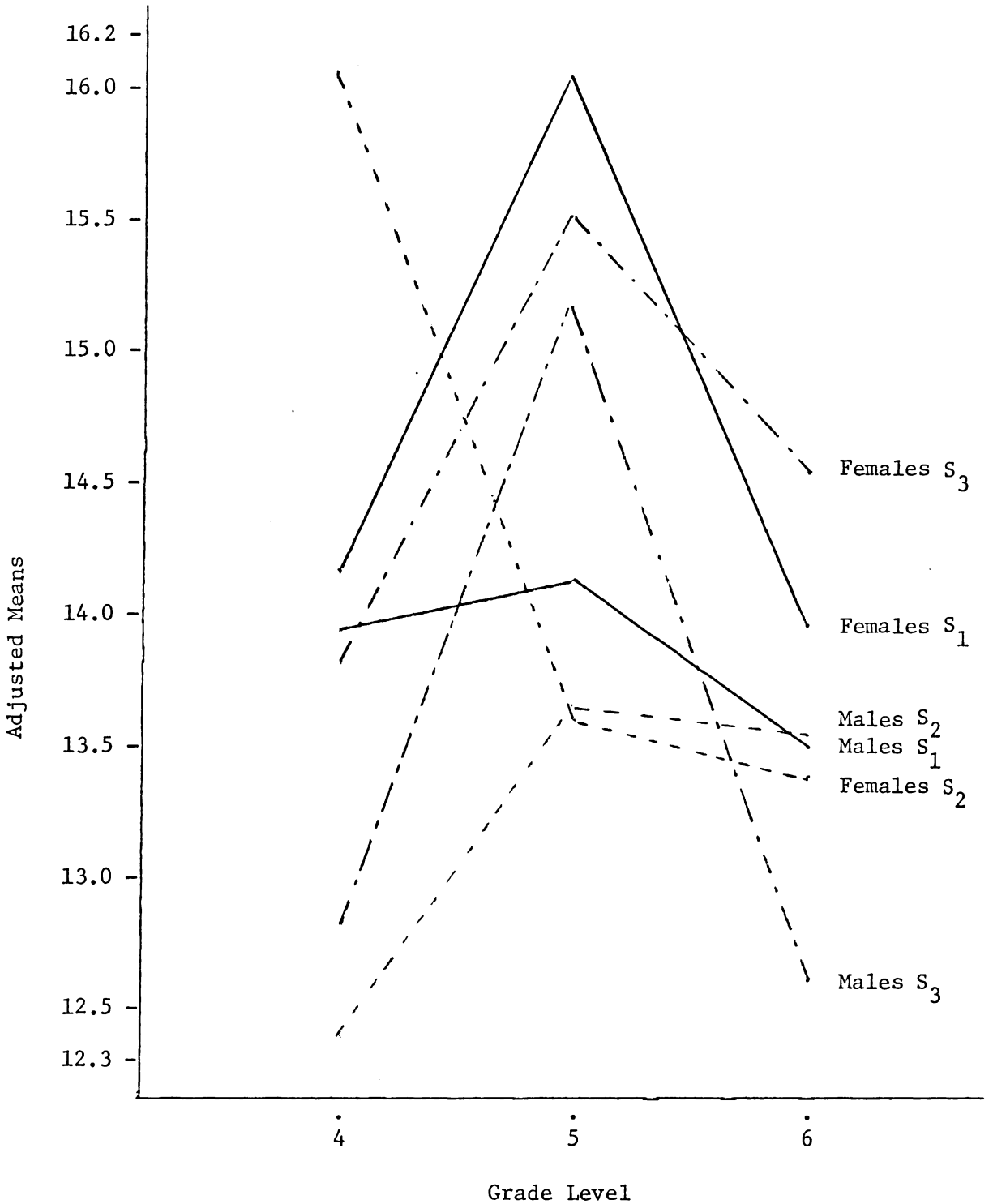

Figure 1. Group by Grade by Sex Interaction
Adjusted Means

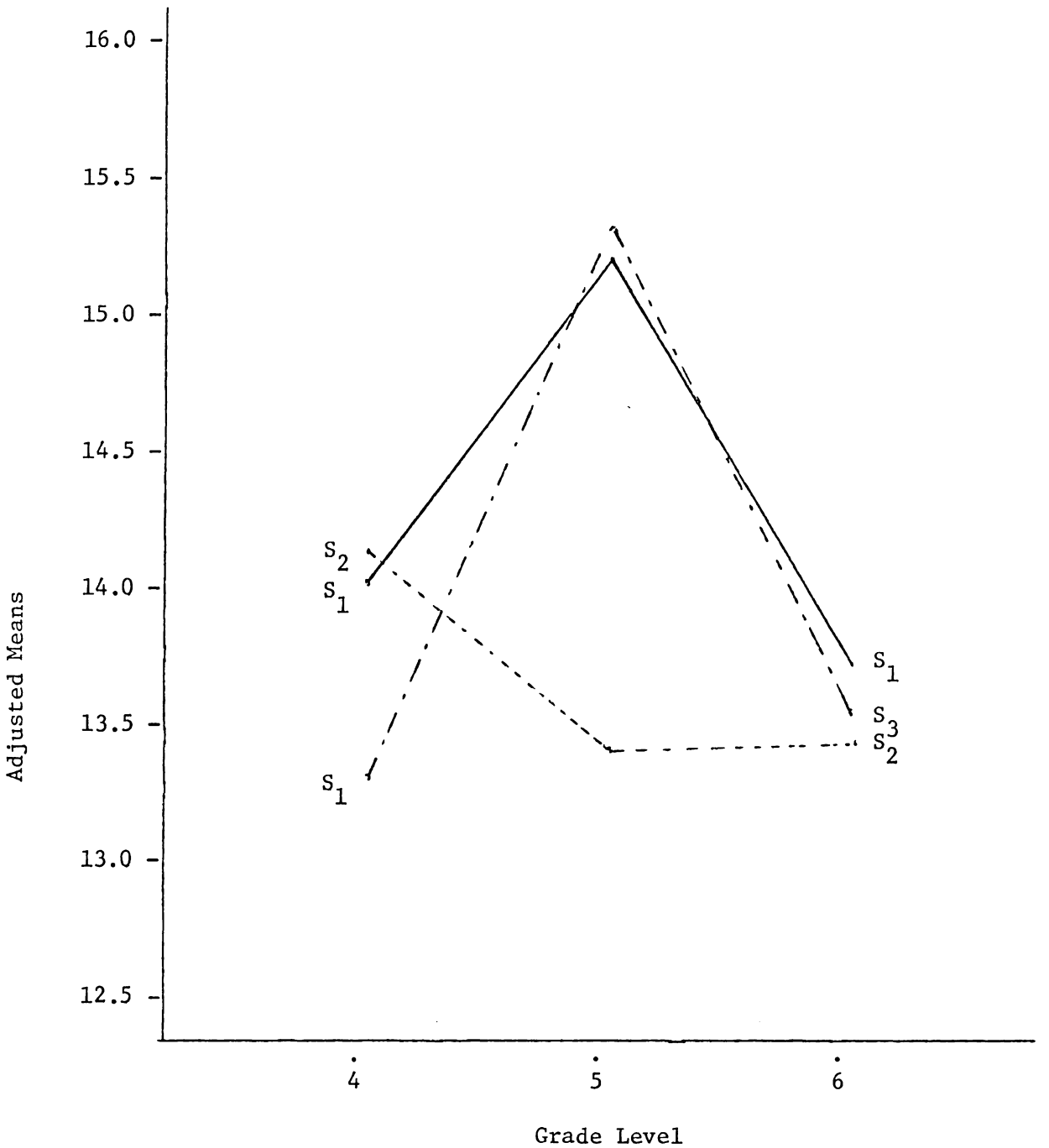

Figure 2. Group by Grade Interaction Adjusted Means

higher in the fifth grade than any other group and grade. Both treatment groups scored higher than the control group. The sixth grade means were extremely close for all three groups.

Students in Grade Eight

The eighth grade students' SRA scores were used as independent variables and the posttest knowledge test as the dependent variable in a stepwise regression analysis to determine which scores or combination of scores should be used as covariates to adjust the student scores in an analysis of covariance. The results of this analysis, summarized in Table 15, indicated that the SRA reading scores accounted for 54.87 percent of the variance in the students' cognitive scores. This score was entered into the subsequent analysis of covariance. The other five variables were not used as covariates because they collectively accounted for only four percent of the total variance in the cognitive scores.

The pretest scores and the SRA Reading scores were used as covariates to adjust the posttest scores. The results of this analysis (Table 16) indicated that there were no significant differences between the three groups.

Affective Data

All students completed the Environmental Semantic Differential. This instrument yields three scores: evaluative score, potency score, and activity score.

Table 15

Regression Analysis Eighth Grade Cognitive Posttest Scores as the Dependent Variable Using SRA Scores as Independent Variables

Variable	Multiple R	R Square	R^2 Change
SRA Reading	.7407	.5487	.5487
SRA Social Studies	.7537	.5682	.0195
SRA Composite	.7597	.5772	.0090
SRA Science	.7631	.5824	.0052
SRA Math	.7670	.5883	.0059
STEA	.7674	.5890	.0007

n = 178

Table 16

Analysis of Covariance Eighth Grade Cognitive Scores Pre-Test and SRA Reading Scores as Covariates

Source	S.S.	D.F.	M.S.	F Value	Probability
Between groups	5.527	2	2.764	.372	.690
Within groups	1212.	163	7.439		

n = 178

Previous studies (Leith, 1974) have indicated that the evaluative scale provides the most discrimination between groups; therefore, descriptive statistics for the evaluative scale score are reported in Table 17. Inspection of these data indicates that the treatment group scored less than one raw score point higher than the control group on the pre-test but were more than six raw score points higher on the posttest. The second treatment group (S_2) mean was lower than both the treatment group and the control group means on the pre-test but the mean for group S_2 was one point higher than the control group mean and almost five points lower than the treatment group mean on the posttest.

The data from the SRA tests were also used in a regression analysis with the attitude data to determine if any of these data should be used to adjust the means in an analysis of covariance. The results of this analysis (Table 18) indicated that the six variables, STEA, SRA Composite, SRA Reading, SRA Math, SRA Science and SRA Social Studies, collectively accounted for only 2.2 percent of the variance. These variables were not, therefore, used in the subsequent analysis of covariance.

The posttest attitude data were adjusted for the pre-test affective data for the three subscales using a multivariate analysis of covariance. The multivariate test of significance using the Wilks Lambda criterion tests (Table 19) indicates that there is a significant difference between the three groups on the variables.

In these analyses Variable 1 was the evaluative scale; Variable 2, the potency scale; and Variable 3, the activity scale.

Table 17

Descriptive Statistics Pre- and Posttest Student Affective Data

Test	Scale	Group	N	Mean	Standard Deviation	Standard Error
Pre	Evaluative	S_1	239	153.339	29.960	1.938
Post				168.280	16.448	1.064
Pre	Evaluative	S_2	171	149.216	30.363	2.322
Post				163.339	18.982	1.452
Pre	Evaluative	S_3	255	153.137	24.261	1.519
Post				162.259	15.513	0.971
Pre	Evaluative	Total	665	152.201	28.036	1.087
Post				164.701	16.990	0.659

Table 18

Regression Analysis Using Student Affective Scores as the Dependent Variable and the SRA Scores as Independent Variables

Variable	Multiple R	R Square	R^2 Change
SRA Composite	.07255	.00526	.00526
STEA	.14385	.02069	.01543
SRA Math	.14747	.02175	.00105
SRA Reading	.14779	.02184	.00009
SRA Social Studies	.14842	.02203	.00019
SRA Science	.14848	.02205	.00002
n = 665			

Table 19

Student Affective Data Using Multivariate Analysis of Covariance - Group by Grade by Sex Interaction

Test of Roots	F	Probability Less Than
1 through 3	2.282	.002
n = 640		

The group by grade and the group by sex interactions indicated no significant differences between the groups. The group by grade interaction was significant. Table 20 summarizes the results of this analysis.

Table 20

Multivariate Analysis of Covariance on Student Attitude Data - Group by Grade Interaction

Test of Roots	F	Probability Less Than
1 through 3	2.426	.001
n - 640		

Univariate F tests were used to detect the nature of these differences. The results of these tests (Table 21) indicates that while there was a significant interaction on all three scales, the evaluative scale showed the largest difference.

All three of the scales may be considered significantly different. Due to the strength of the evaluative value and the conflicting results of previous studies (Leith, 1974) showing that the activity and potency scales provide the least amount of discrimination between groups, the results of the evaluative adjusted means were investigated.

Figure 3 shows that fourth grade S_1 males and females scored higher than the other two groups. The fourth grade females in the second treatment group scored significantly higher than the fourth

Table 21

Univariate F tests on Student Attitude Data - Group by Grade Interaction

Variable	F(6,638)	Mean Square	Probability Less Than
Evaluative Scale	4.066	986.2	0.001
Potency Scale	2.220	287.2	.040
Activity Scale	2.627	409.9	.016

n = 640

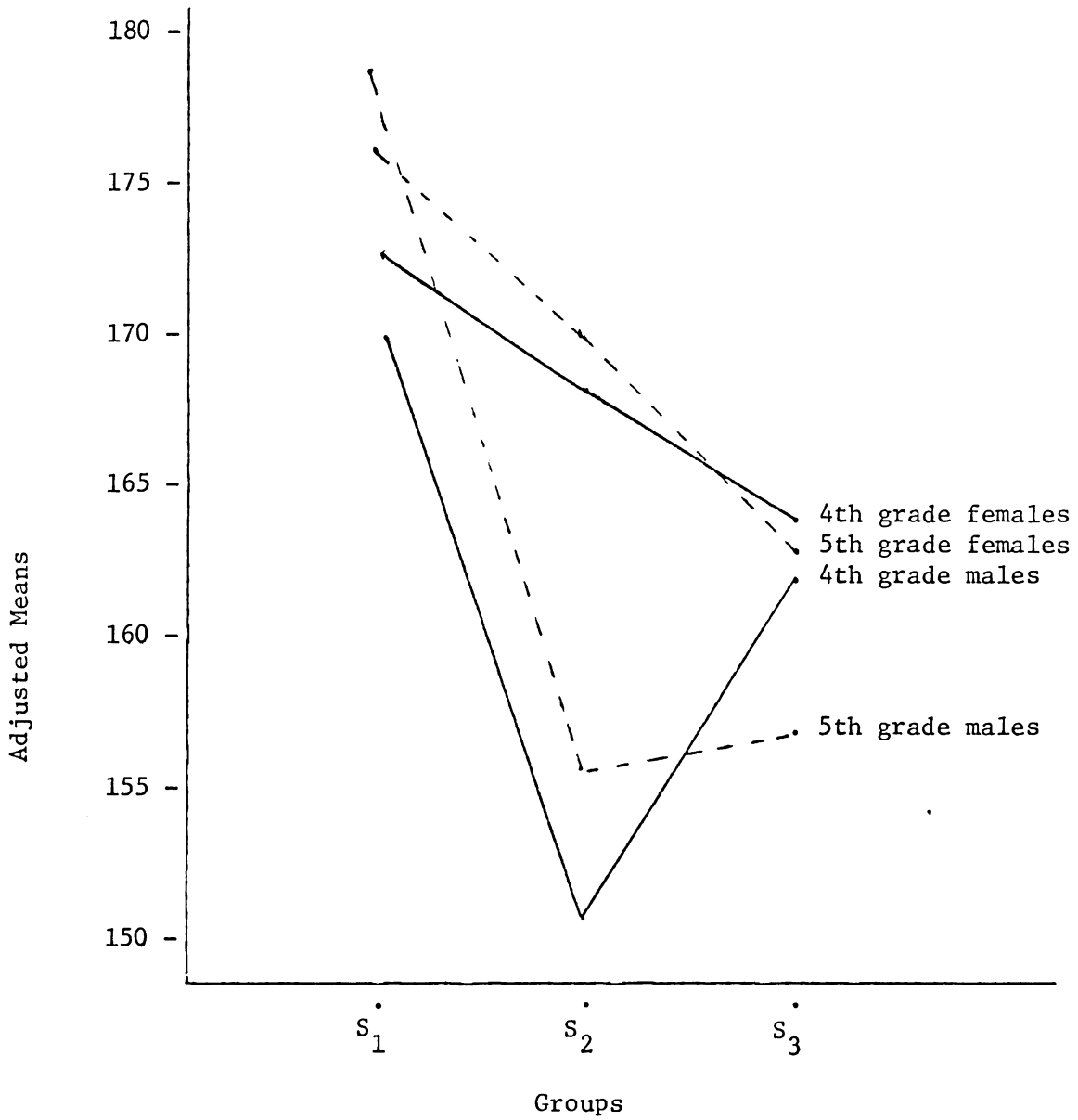

Figure 3. Adjusted Evaluative Means for the Groups by Grade by Sex Interaction with Grades Four and Five.

grade males. The fifth grade results were the same as the fourth grade results for both sexes.

Figure 4 illustrates the group by grade by sex interaction for the sixth and eighth grade students. The sixth and eighth grade females scored higher than their male counterparts. The eighth grade females for all three groups responded higher on the evaluative scale than all other groups except the fourth grade females, fifth grade females and fifth grade males.

Figure 5 illustrates the group by grade interaction. This interaction was analyzed with the Newman-Keuls test. The following results were found. The fifth grade treatment group was the only group to show significantly higher means than the other groups. The adjusted means for this group were higher than the fourth grade S_2 group, the sixth grade control group, and the fifth grade control group at the .01 level. When the significance level is increased to .05 this group exhibited higher means than the sixth grade treatment group, the fourth grade control group and the second treatment groups for the fifth and sixth grades.

These data were analyzed using the Newman-Keuls multiple comparisons test to detect the group or groups that accounted for the differences. The group effect (Figure 6) indicated that the groups were significantly different; the Newman-Keuls test revealed that the treatment group scored significantly higher than the control group at the .01 level and higher than the second treatment group at the .01 level. There were no differences detected between the second treatment group and the control level.

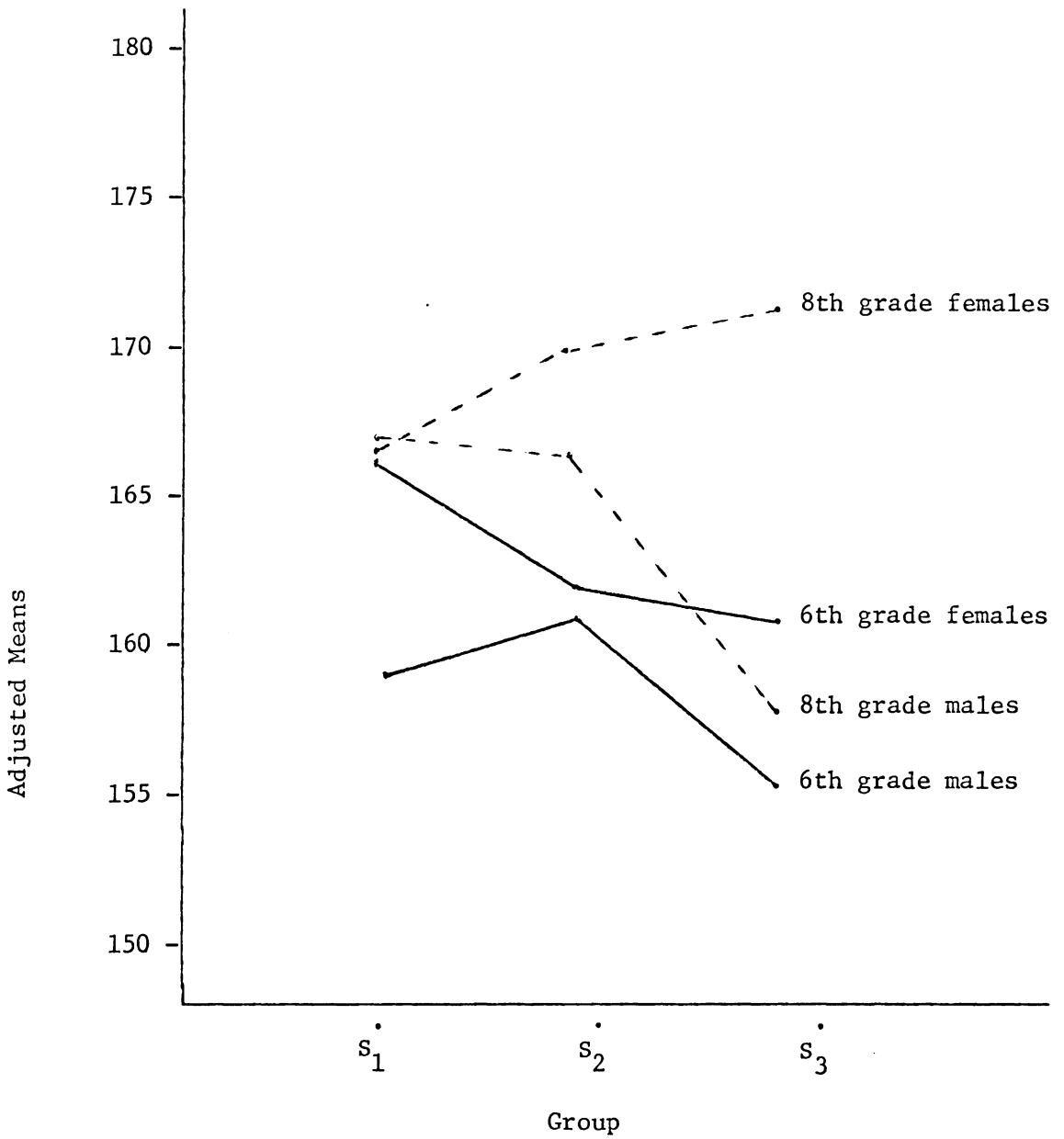

Figure 4. Adjusted Evaluative Means for the Group by Grade by Sex Interaction With Grades Six and Eight.

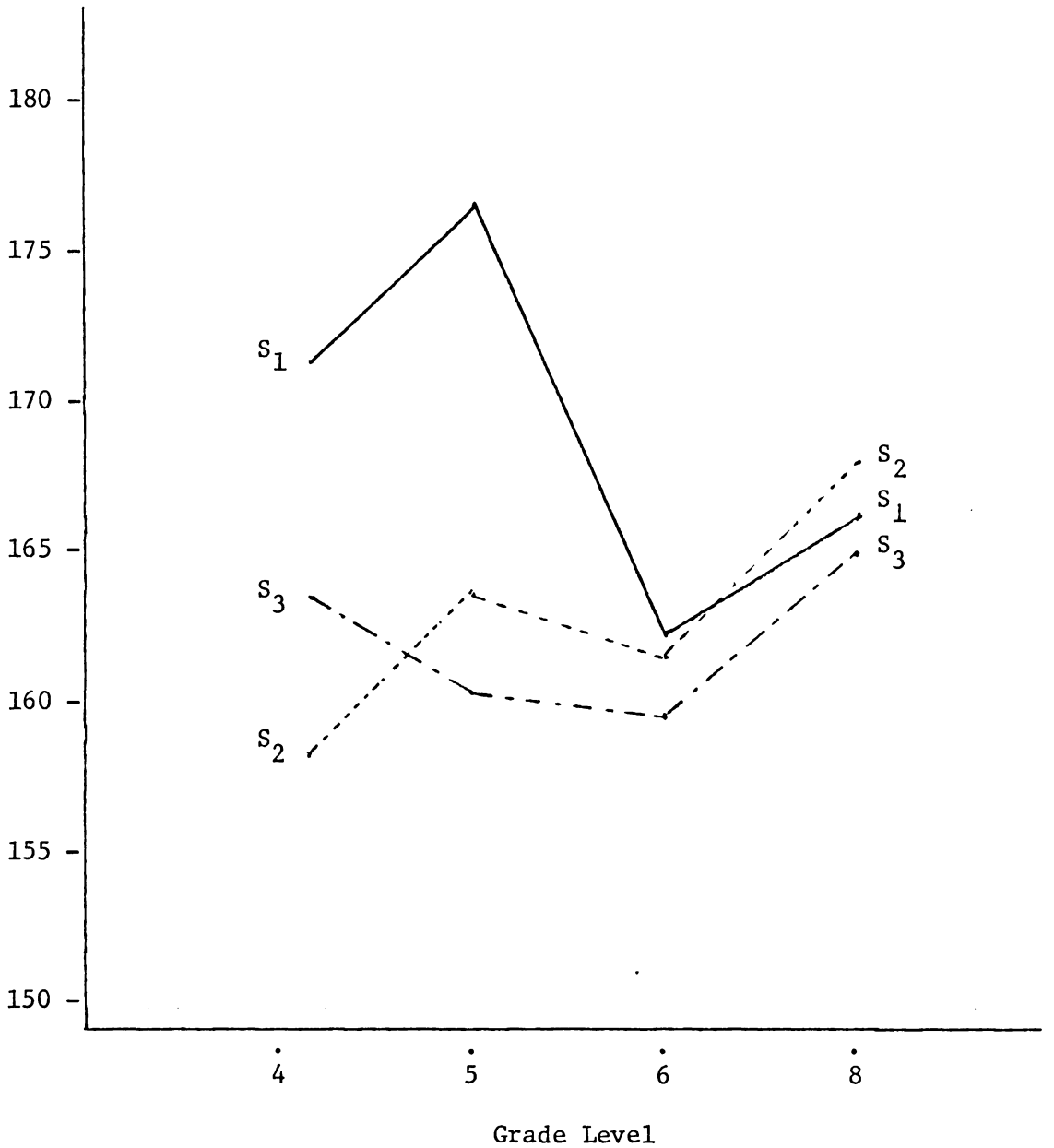

Figure 5. Adjusted Evaluative Means for the Group by Grade Interaction

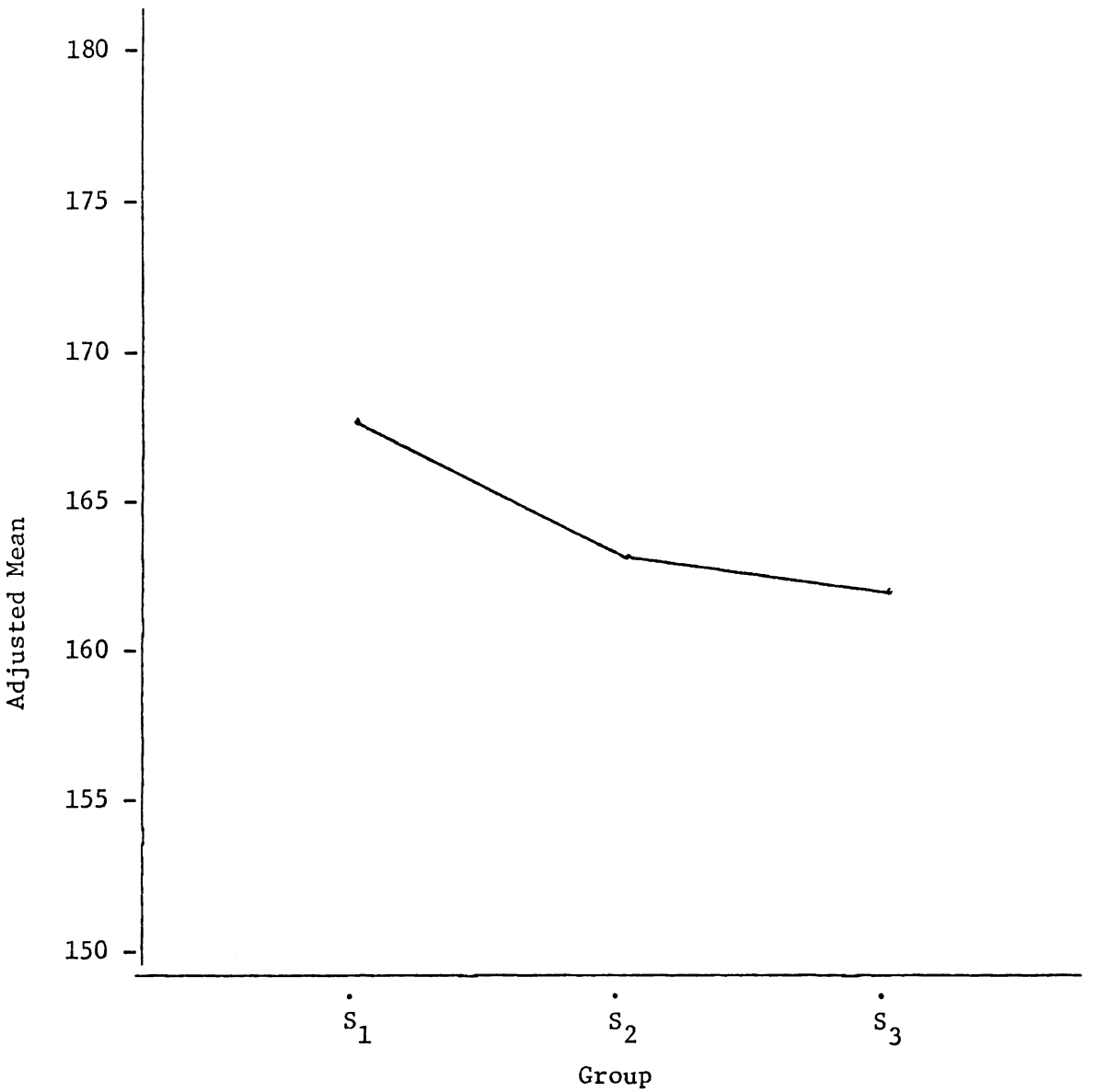

Figure 6. Adjusted Evaluative Means by the Main Effect Group

SUMMARY

Teachers

The analysis of the teacher cognitive data indicated that there were no significant differences between the groups on either the pre-test or posttest data. The analysis of covariance indicated that any differences that existed were accounted for by the differences in the pre-test scores.

The analysis of teacher attitudes showed that the treatment teachers increased their attitude scores between the pre-test and the posttest when analyzed by a t-test for dependent samples. The analysis of covariance yielded no significant differences. Both of these tests were, however, confounded by insufficient sample size. The teacher results are inconclusive.

Students

There were no significant differences in the adjusted means for the student cognitive data for the three groups. There were some grade level differences noted for the fourth, fifth and sixth grade groups but these differences were not of concern with respect to this study.

Differences in the adjusted attitude test means were detected. The treatment group means were significantly higher than the means of the other two groups on the evaluative subscale. The second treatment group did not show a significant increase over the control group on this measure.

Chapter 5

SUMMARY, DISCUSSION AND CONCLUSIONS

The problem this study investigated was to examine the nature and extent of attitude and knowledge changes that took place as a result of different levels of participation in an environmental education program.

DISCUSSION AND SUMMARY OF FINDINGS

Teacher Cognitive Changes

One of the hypotheses generated by this study was concerned with teacher knowledge. This hypothesis was tested to detect differences between the three groups of teachers. There were no differences among the three groups when the posttest means were adjusted for the pre-test means. The means for the treatment group were lower on the posttest than the means for the other two groups on all scales and the total score. The desired "carry over" effect was not detected. The second treatment group performed as well as the primary treatment group and the control group on the cognitive measure. There was not a norming group to compare these test results with, however, a group of teachers, science supervisors and administrators from throughout the State of Virginia who participated in an environmental education program in the summer of 1974 were administered the same instrument (Wileman, 1974). The pre-test means of the Prince William teachers were higher than the pre-test means and lower than the posttest means of this sample. Since

these two projects were attended by interested individuals, the test scores may not be representative of a random sample of teachers.

Teacher Affective Changes

The measurement of the teacher attitudes was undertaken to test the second hypothesis listed in Chapter 4. The teachers showed no significant increases on the affective measure when the posttest means were adjusted based on the pre-test means by an analysis of covariance. Those teachers who completed the program did increase significantly on all scales and the total affective score. This difference was tested by the use of t-tests for dependent samples. One possible reason this difference was not detected by the analysis of covariance was because of the small sample size for the second treatment group and the control group.

Student Cognitive Changes

One of the hypotheses generated for this study concerned changes in the students' cognitive level. The student cognitive means for all grade levels were adjusted for the students' SRA reading scores. The SRA reading scores were found to account for thirty-three percent of the variance in the posttest cognitive scores.

The results for the fourth, fifth and sixth grade students, when analyzed with a three way analysis of covariance, indicated that there was a significant group by grade interaction. Further analysis of this data indicated that both the fifth grade treatment group and the fifth grade control group scores significantly higher than the other groups.

This would indicate that while the test had an acceptable reliability coefficient it tended to behave erratically when used with multiple grade levels. The results of the eighth grade students showed no differences among the three groups.

Student Affective Changes

The hypothesis concerning the students' affective changes was confirmed by a multivariate analysis of covariance and the Newman-Keuls multiple comparisons test. The adjusted means for the treatment group was significantly higher than the means of the other two groups. There was not a significant difference between the second treatment group and the control group.

When the evaluative scores were analyzed by an analysis of covariance there was a significant treatment level difference. The treatment group means were significantly higher than the means for the other two groups. The difference between the second treatment group and the control group was not significant.

There was a group-by-grade interaction for the evaluative subscales. Analysis of this interaction indicated that the fifth grade treatment students' means were significantly higher than several of the other groups.

There was a significant group-by-grade by sex interaction on all three scales. The adjusted means for the evaluative scale were graphed and the fourth and fifth grade females along with the fourth grade males scored higher than all other groups. The scores for the

eighth grade females were as high as these three groups, however, their difference may be due to confounding affects associated with this age group female. These would include such things as the higher maturity level of eighth grade students in general and females specifically.

CONCLUSIONS

The environmental education project described in this study was more successful in affecting student attitudes than it was in affecting their cognitive levels or the cognitive and affective levels of the teachers.

The lack of increases in the teachers cognitive level can probably be attributed to two factors. First, the cognitive level of both the participants and other teachers tested was relatively high before the treatment began. Second, the materials and methods seminars were not designed to increase the cognitive level of the participants but rather to provide improvements or alternatives to the materials and methods previously used by the teachers. The subject matter seminars were designed to cover content areas that should have affected the teachers' level of cognition. These seminars, however, were attended by approximately twenty percent of the participants. This low level of participation along with the previous reason probably affected this desired outcome.

An increase in the students' level of cognition was a subject investigated by this study. The results of the analysis of the cognitive

data for the three groups indicated that this effect was not detected. One possible reason for this could be the instrument chosen for the fourth, fifth and sixth grade measure. The results of the analysis on these data seem to indicate that the test behaved erratically across grade levels.

While the increase in the teachers' attitude scores could not be directly linked to the treatment, through an analysis of covariance, the results were probably affected by the very small sample size for the second treatment group and the control group. Analysis of the teacher data for those who completed the project showed significant increases on all subscales and the total score for the attitude measure. The teacher results, however, must be regarded as inconclusive.

The increase in the students' affective scores would tend to indicate that the methods and materials introduced to the teachers in the project were transferred to the students. The higher performance level of the fifth grade treatment students when compared to the sixth and eighth grade students could be attributed to two conditions. First, the fifth grade students are taught in self-contained classrooms, therefore, the effect of interaction with one teacher seems to be important. This conclusion would seem to be supported by the fact that the fourth grade treatment students affective mean scores were higher than the other groups and close to significant. The sixth and eighth grade students were exposed to more than one teacher and the criteria for their being placed in the treatment group was that at least one of their teachers was a participant in the project. The lower means for the sixth and eighth grade students could be attributed to too few of their

teachers being involved. The second factor could be the level of commitment and level of participation of the fifth and fourth grade teachers. Since these teachers teach in self-contained classrooms and are responsible for all subject areas, they may have been able to make immediate use of more of the materials presented during the project. The group by grade by sex interaction can be explained by these same reasons.

DISCUSSION

The semantic differential seems to be a viable instrument for measuring students attitudes toward the environment. The instrument used in this study was composed of the three scales described by Osgood (1957). The results of this study would indicate that comparable results could have been obtained by a scale utilizing the evaluative scale only. The use of the evaluative factor would result in a shorter test for the student and one which is fairly simple to score and interpret. The semantic differential used in this study places minimum emphasis on the students reading ability. The results of the regression analysis indicated that the reading level of the students accounted for an extremely small percentage of the variance in the total attitude score and the evaluative subscore. Additional research is needed to determine if this semantic differential or one containing only evaluative items will correlate with another scale dealing with environmental issues.

The erratic behavior of the fourth, fifth and sixth grade cognitive measure across grade levels would point out the need for an

instrument to measure elementary students' knowledge about the environment. This would be needed for any study across grade levels or if one were to undertake a longitudinal study. In addition, the amount of variance accounted for by the students' reading ability would indicate that an instrument to measure the students' knowledge should be developed that places minimum emphasis on reading. The success with the semantic differential using slides as concepts may suggest a type of cognitive test that would satisfy this need.

The changes in the students' attitudes without a concomintant change in the teachers' attitudes is interesting. It is quite possible that the materials and methods type of seminars did not change the material or subject matter included in the county curriculum, but caused changes in either the way the material was presented or the emphasis given the material resulting in the increase in students' attitudes. It is also possible that the instrument did not measure the areas where changes occurred.

The lack of changes in the teachers' cognitive level suggests that this was not the best hypothesis to be tested. The teachers were given materials and methods curriculum workshops. A measure of the changes in teaching procedure or processes might have been a more appropriate procedure. The problem with this type of study would be to achieve a reliable measure of the teaching processes subject to change. If students are to be used to attest to the changes, the vocabulary and reading level problem would again cloud the measurement.

Based on the findings of this study, concerning student attitudes, I would conclude that funding of this type of program would be in order. The program was successful in changing the students' attitudes toward the environment. This type of success is very important if the premise of "changing attitudes to change behavior" is acceptable.

The recommendations and suggestions, based on this study, for future investigations would include:

1. the development of an environmental knowledge measure for elementary students;

2. the refinement and simplification of the semantic differential to include the evaluative scale only;

3. the use of direct observation as well as paper and pencil indications of process changes that might take place in teacher behavior; and

4. the investigation of a possible relationship between teaching method and attitude change.

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APPENDIX A

STUDENT BASE LINE DATA
SRA SCORES BY GROUP BY GRADE

Fourth Grade Students

Variable	S_1	S_2	S_3
N =	56	25	68
STEA	113.3	105.2	117.0
SRA Composite	298.3	258.8	276.5
SRA Reading	300.9	257.7	276.5
SRA Math	274.3	248.2	258.9
SRA Social Studies	301.1	255.8	275.7
SRA Science	292.1	257.4	278.1

Fifth Grade Students

Variable	S_1	S_2	S_3
N =	40	43	65
STEA	86.1	63.8	83.7
SRA Composite	223.8	150.4	207.5
SRA Reading	222.2	164.9	213.4
SRA Math	209.6	147.1	203.3
SRA Social Studies	224.4	170.1	214.8
SRA Science	227.9	165.8	218.5

Sixth Grade Students

Variable	S_1	S_2	S_3
N =	71	49	70
STEA	102.887	103.8	101.5
SRA Composite	338.2	343.9	318.5
SRA Reading	321.6	319.5	296.9
SRA Math	313.2	313.7	308.9
SRA Social Studies	331.2	340.5	319.0
SRA Science	311.9	307.4	297.4

Eighth Grade Students

Variable	S_1	S_2	S_3
N =	72	56	56
STEA	107.6	107.6	99.4
SRA Composite	441.0	430.7	355.7
SRA Reading	378.9	373.6	331.4
SRA Math	396.3	392.4	360.1
SRA Social Studies	413.4	394.0	341.7
SRA Science	370.6	364.3	315.9

APPENDIX B

ENVIRONMENTAL SEMANTIC DIFFERENTIAL, AND INSTRUCTIONS FOR ADMINISTRATION

INSTRUCTIONS FOR ADMINISTERING THE ENVIRONMENTAL SEMANTIC DIFFERENTIAL

"You will be shown some color slides and will be asked to tell what these pictures mean to you; how they make you feel. Then you will be asked to mark or rate each picture according to the twelve pairs of words on each sheet.

Let's try one on the separate practice sheet. (Show picture of sail boat). Notice that there are seven spaces between each pair of words. Place a check mark in the space that tells how the picture makes you feel. For example, for the first pair of words, good-bad, place your check mark at the good end if the picture makes you feel very good, or any space between good and bad according to how the picture makes you feel." Students were then given an example of how to interpret the seven spaces.

"Go down the page and mark each pair of words as I read them. Mark each pair of words as to how they make you feel. Try to tell me exactly how the picture makes you feel. Do not think about it very long. Mark the first meaning that comes to you." Circulate through the group to check whether the students understand the instructions. Watch for those who just check the middle space.

Now, start the eight page test. Make sure students are on the correct page for each slide.

1.	Good	____:	____:	____:	____:	____:	____:	____	Bad
2.	Small	____:	____:	____:	____:	____:	____:	____	Large
3.	Fast	____:	____:	____:	____:	____:	____:	____	Slow
4.	Unpleasant	____:	____:	____:	____:	____:	____:	____	Pleasant
5.	Strong	____:	____:	____:	____:	____:	____:	____	Weak
6.	Quiet	____:	____:	____:	____:	____:	____:	____	Active
7.	Clean	____:	____:	____:	____:	____:	____:	____	Dirty
8.	Light	____:	____:	____:	____:	____:	____:	____	Heavy
9.	Hot	____:	____:	____:	____:	____:	____:	____	Cold
10.	Worthless	____:	____:	____:	____:	____:	____:	____	Valuable
11.	Soft	____:	____:	____:	____:	____:	____:	____	Hard
12.	Dull	____:	____:	____:	____:	____:	____:	____	Sharp

Description of Color Slides Used in the
Environmental Semantic Differential

Slide #1	Several ducks swimming in a running, relatively unpolluted stream.
Slide #2	A crowd of interracially mixed smiling children, fairly well dressed.
Slide #3	A silhouette of a tree against the background of a beautiful sunset.
Slide #4	Ducks feeding in the grass at the edge of a pond or lake which contains some trash and debris.
Slide #5	A meadow scene showing a close-up of some wild flowers and grasses.
Slide #6	A collection of overflowing garbage cans along a brick wall. Sign above trash says "Please Put Trash in Cans".
Slide #7	A beach scene showing a very overcrowded beach.
Slide #8	A scene of a fast flowing river over some rapids.

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THE EXTENT AND NATURE OF AFFECTIVE AND COGNITIVE CHANGES IN TEACHERS AND STUDENTS AS THE RESULT OF PARTICIPATION IN AN ENVIRONMENTAL EDUCATION PROGRAM

by

Joseph Lawrence Wileman

(ABSTRACT)

The effect of participation in an environmental education program on the cognitive and affective growth of teachers and students was investigated. Fourth, fifth, sixth and eighth grade teachers from selected schools in Prince William County Virginia, were enrolled in an environmental education project funded by the National Science Foundation. These teachers, teachers who taught in the same school but not enrolled in the project, and teachers from schools (control) not involved in the project composed the three teacher groups for the study. The students of these three groups of teachers were the student groups of interest in the study.

The three groups of teachers were administered environmental attitude and environmental knowledge measures. Analysis of the data indicated that hypothesized differences between the groups were inconclusive.

The students, while not treated directly, were administered an Environmental Semantic Differential, as an attitude measure and a knowledge test. Analysis of covariance indicated that there was a significant group by grade by sex interaction, with fifth and fourth

grade treatment females scoring significantly higher on the attitude measure than the other groups.

The results of the analysis of these student attitude data provide evidence of both the effectiveness of the environmental education program and the use of the semantic differential as a measurement of students' attitudes toward the environment.