DEVELOPMENT AND UTILIZATION OF AN ATTITUDE SCALE TO DETERMINE EFFECTS OF A HIGH SCHOOL ECOLOGY COURSE

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N. David Acland

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DEDICATION

This work is dedicated to my late father, Noel Brian Acland, whose encouragement and faith were the prime motivators of this thesis.

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David Acland.

ABSTRACT

The purpose of this study was to develop an instrument, the Environmental Appreciation Survey, to measure environmental attitudes, and to use it to determine the effects overall and according to grade level and sex of an Ecology course developed for use at the secondary school level in Manitoba.

First semester classes from September 1974 to January 1975 consisting of 112 students in Ecology, Botany and "Genetics and Evolution" at Vincent Massey Collegiate in Fort Garry, Manitoba were used as an aid to developing and refining the instrument. Second semester classes from January to June 1975 consisting of 70 Ecology students from grades 10, 11 and 12 and 48 "Genetics and Evolution" students from grades 10, 11 and 12 were selected as the treatment group and control groups respectively. The sex ratio was approximately ½ male and ½ female and ages ranged from 15 to 18 years in both groups.

A 25 item Likert type instrument was developed to measure student attitudes to specified factors selected as being central to the Ecology course. Content and predictive validity were established for

the instrument. Reliability was established through tests of internal consistency and test retest reliability.

A pretest posttest control group design using the Environmental Appreciation Survey in each case was employed.

Non parametric statistics were used to analyze the data. Kolmogorov-Smirnov Two Sample Tests were used when two groups were compared and Kruskal-Wallis One Way Analysis of Variance Tests were used when the three grade levels were compared.

Analysis of the data revealed that the treatment and control groups were initially equivalent based on a test of similarity conducted at the .10 level of confidence. On a posttest comparison the treatment group was found to have significantly higher attitude scores than the control group at the .05 level of confidence. Only minimal differences were found between males and females, with the males showing significant improvement in more areas of the attitude component than the females. The grade 11 and 12 students showed significant attitude improvement, while the grade 10 students who scored the highest on the pretest and posttest did not.

The major implication of the study appears to be that an Ecology course at the high school level can significantly improve environmental attitudes as measured by the instrument developed. An additional implication is that since students from the different grade levels were found to be significantly different at the beginning, as well as differentially affected by the course, that the students from the three grade levels might benefit most from different approaches to instruction.

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CHAPTER I

INTRODUCTION

Purpose

The purpose of this study was to develop an instrument to measure environmental attitudes, and use it to determine some effects of an Ecology course developed for use at the secondary school level in Manitoba.

The following questions are based on the specific effects to be studied:

1. Does a course in Ecology have an effect on students' environmental attitudes?
2. Does grade level have an effect on students' environmental attitudes?
3. Does the sex of the student have an effect on environmental attitudes?
4. Do attitudes as measured by the total scale or by the different factors which make up the environmental attitude scale change differentially overall or with respect to grade level or sex?

Need for the Study

Educators in Manitoba in 1975 are embarking on new academic pathways that allow for a great deal of freedom for school divisions, school teachers and indeed students. With this new freedom, however, comes new responsibilities both for professional educators

and for students to develop strategies for introducing and evaluating planned curricular innovations.

It is necessary to draw upon many areas of knowledge while working with a staff and a community on an innovation. One must deal not only with the knowledge and processes of the particular disciplines underlying subject areas found in the school program, but also with other components of the curriculum that the learner encounters in the classroom, including features of the school system and the school that characterize them as social systems, economic and political factors, curricular planning processes, human relations and communication.

The uniqueness of the individual school, school system, community, teacher corps and pupil groups have received inadequate attention as the current plethora of curricular, organizational, and material innovations have been introduced into the schools and school systems. In many situations, innovations have been introduced without thoughtful analysis of the appropriateness and sophistication of the content and materials for the target group. As well, many claims are often made on behalf of the innovations, but seldom is a study done on the validity of the claims. Often, not

enough attention has been given to relationships with other courses.

In December of 1974, A Provincial Ecology Committee, of which the author is chairman, was established with the stated purpose of developing a course at the grade eleven or twelve level to meet the needs of those students who wish to have additional studies in biology, and those students who may be interested in this particular aspect of biology.

The main goal of the course to be developed was to create in students positive environmental attitudes. In order to do this the course was designed to give students the opportunity to increase their awareness of their environment and the forces acting upon it, to learn to investigate environmental problems, to reflect on man's place in the environment and to examine the value choices which have such a bearing on their future.

The importance of attitude in relation to environmental problems was expressed by Swanson (1975) when he stated:

> Environmental problems arise because man is somewhere in the picture, and they must be defined in terms of man. When man makes use of an

> environment to maintain or improve his way of life, he does so within a system of ideas which reflects his attitude toward nature and himself. (Swanson, P. 85.)

The Ecology course developed was designed to explicitly or implicitly attempt to shape or alter attitudes toward environmental issues. Because attitudes toward a referent influence behavior toward that referent, it is desirable to test the effectiveness of any environmental program in influencing or affecting attitudes of groups toward environmental issues. This study, by developing and testing an instrument related to attitudinal effects of a specific course, is designed to meet this need.

Definition

The following term is defined because it is being used in a specific sense in this study.

Ecology Course

This refers to a particular half-course of 55 contact hours in Ecology developed by the author for use at the secondary school level and first tested at Vincent Massey Collegiate, Fort Garry, Manitoba. A brief outline of the course is presented in Chapter four. The complete description of the course is available from the Curriculum Branch of the Manitoba Department of Education (Register of School Initiated

Courses, 1974). This course has served as the basis for the provincial 305 Ecology course developed in June, 1975.

Delimitations

The study relates to a particular Ecology course as already defined. The study does not apply to other courses with different aims and objectives.

Limitations

1. The study was limited to only one school. Ten classes with a total of approximately 230 students were involved.
2. The students involved in the study were assigned to specific classes on the bases of course selection. This was the consequence of an administrative condition which made it impossible to randomly select students for the study.
3. The results of the study may have been affected by the use of the same measuring instrument for both the pretest and the posttest. Any practise effect due to using the same instrument would impose a limitation on the study.
4. A subjective evaluation of the students in the study suggests that the sample is not representative with respect to the socio-economic

background. The majority of the students in the sample are from middle and upper-middle class homes.

Basic Treatment and Overview

An attitude measuring instrument was designed and developed to measure some effects of an Ecology course. First semester classes (September to January) at Vincent Massey Collegiate in Fort Garry, Manitoba, were used as an aid to refining the instrument. Second Semester classes (January to June) of Ecology and "Genetics and Evolution" students were selected as the treatment group and control group respectively. The Ecology course was given and data was collected and analyzed in order to test the hypotheses and provide answers pertaining to the questions about effects already posed in this chapter. The hypotheses are fully outlined in Chapter three.

Following a review of the literature in Chapter two a more extensive description of the study is given in Chapter three. Chapter four describes the development and refinement of the instrument used to measure the effects. In Chapter five the data is analyzed and Chapter six presents the summaries and conclusions.

CHAPTER II

REVIEW OF RELATED LITERATURE

Within any high school biology class a teacher can be certain that the class contains some students who are capable of abstract thought and others who must think in terms of objects, events or situations, and who cannot develop understanding of concepts that require the use of assumptions, axioms, or any type of verbally expressed hypothesis. The Swiss psychologist Jean Piaget (1964) refers to those two types of thought as formal and concrete operational respectively. Grant and Renner (1975) reported that prior research has shown that grade ten high school biology classes are composed of approximately 65% concrete operational thinkers.

Piaget says comparatively little about emotional development, but he does not overlook or deny the importance of feelings or affects. Piaget (1950) concedes that every intelligent act is accompanied by affects and that these provide the energy that sparks intellectual growth. He believes that every action involves a structural or cognitive aspect and an energetic or affective aspect. He views the two as inter-

dependent, with emotional development requiring the same continuing process of adaptation as cognitive development.

In more recent years educators have begun attempts to define the "affective domain" modeled on the findings of developmental psychology. A number of social psychologists (Hunt 1970; Kohlberg 1971; Harvey 1966; Jung 1971) have proposed levels of affective and cognitive awareness for those of adolescent years and beyond.

Kohlberg (1971) has proposed a six stage developmental model for the development of an individual's value system. The stages do not represent specific values or virtues; they are marked by the individual's ability to see and to offer justifications for certain decisions in value conflict situations. The model is cognitive in its orientations, stressing reasoning and the kinds of motives one uses to justify decisions involving values. According to Kohlberg, each person develops sequentially from the lowest stage upwards. However, not all persons reach the higher stages.

The key educational message of the Kohlberg model is, that while students can attend cognitively and learn facts about all stages, it is by attending to

arguments at the next higher stage that students develop a value system. A teacher who has a class of students who use stage two and stage three reasoning may study the situation of increasing consumption of non-renewable resources by the developed countries, and get students to learn the "facts". While that may be important for other objectives it is not going to promote growth in the affective domain. Attempts to raise the level of students as early as the fifth grade have been successful (Shymansky & Matthews, 1974).

In recent years an increasing number of articles and books have appeared addressing themselves to the affective domain. Writing about instructional objectives for school curricula, Krathwohl and Masia (1964) arranged a hierarchy of five levels in the "affective domain". Beginning with "attending and awareness" level, the taxonomy proceeds to an "acceptance of a value", then "commitment" and on to "the organization of a value system", and finally "characterization by a value or a value complex", as the highest level.

Krathwohl and Masia's hierarchy of levels is not dissimilar to Kohlberg's stages in that both are sequential and lead to the development of complex value

systems at the higher stages. Indeed a problem associated with the affective domain is the confusion and conflict over the meaning of key terms. Kuhmerker (1973) recently alluded to the problem in an article entitled "We Don't Call it Moral Education: American Children Learn About Values."

In a discussion on approaches to values education Superka (1974) suggests that there is very little agreement among writers concerning the meaning of the terms "values" and "valuing". He defines values as, "criteria for determining levels of goodness, worth, or beauty which guide the thoughts, feelings and actions of persons." He further defines valuing as, "the process of developing or actualizing values."

While professional use and definition of the term attitude vary widely, Shaw and Wright (1967) have suggested that despite the variation in the meaning of an attitude, a common element that runs through most definitions is the following:

> A predisposition to respond to social objects which, in interaction with situational and other dispositional variables guides and directs the overt behavior of the individual.
> (Shaw & Wright P.2)

Values, therefore, can be thought of as rather abstract ideals while attitudes are predispositions that shape the outward expressions or manifestations of underlying values or value systems.

Attitudes are generally conceived to be relatively stable and enduring. Oppenheim (1966) has suggested that some attitudes are more enduring than others. Some attitudes go much deeper than others and touch upon one's fundamental philosophy of life, while others are relatively superficial. According to Rokeach (1968), the more personal and basic the values, the slower and more difficult the process of change.

Unfortunately, there is little consensus on the parameters, approaches, and objectives for translating this theoretical aspect of the affective domain to values education in the classroom.

The Teaching Guide For The Plover Books (1974), concerns itself with humanistic approaches to environmental education. Four dimensions are suggested for influencing environmental attitudes and values:

1. A critical-appreciative study of other's values.
2. Personal awareness of values and feelings.

3. Ethical reasoning.

4. Lifestyle considerations.

These may be dealt with at any point on the Kohlberg scale, but the object is to assist students to learn at higher levels on that scale. A number of models useful in promoting higher level reasoning are suggested.

In his paper on attitudes and values in environmental education, Knapp (1972), states that research has shown that the following methods have been successful in changing attitudes in some people:

1. Verbal reinforcement
2. Counter-attitudinal role playing
3. Debates
4. Providing new information
5. Introducing anxiety or fear arousing situations
6. Understanding the psychological need for holding a particular attitude
7. Changing certain social factors
8. Adult models
9. Behavior change precedes attitude change

He cautions that research on attitudes about

environmental issues is limited and inconclusive and that teachers should experiment with some of the above techniques which have been successful in changing attitudes in other areas.

Basic to a clearer understanding of attitude change is the refinement of the techniques of attitude measurement. In order to attempt to quantify attitudes it is possible to use attitude scales that provide a quantitative method for assessing an individual's relative position along a unidimensional attitude continuum.

The most frequently used methods of measuring attitude (Thurstone, 1929, 1931; Likert, 1932; Guttman, 1944) require subjects to indicate their agreement or disagreement with a set of statements about the attitude object. Generally, these statements attribute to the object characteristics that are positively or negatively evaluated and rarely neutral.

The function of attitude scales has been described by Oppenheim (1966) in the following terms:

> Attitude scales are relatively crude measuring instruments, and we must not expect too much of them. Their chief function is to divide people roughly into a number of broad groups, with regard to a particular attitude. Such scales

> cannot, by themselves, be expected to provide us with subtle insights into an individual case. They are techniques for placing people on a continuum in relation to one another, in relative and not in absolute terms. (Oppenheim, P.121)

The chief limitations and advantages of the Likert scale were summarized by Oppenheim (1966):

> In practise, if we remember that equal score intervals do not permit us to make assertions about the equality of underlying attitude differences and that identical scores may have very different meanings, the Likert scales tend to perform very well when it comes to a reliable rough ordering of people with regard to a particular attitude. (Oppenheim, P.141)

The Likert type scales are the easiest to construct and correlate well with other scales. They are considered to be unidimensional in that all the items measure the same thing. As well, reliability of Likert scales tends to be good. Oppenheim (1966) has further suggested that they have two other advantages:

1. They provide more precise information about the respondent's degree of agreement or disagreement than do other scales.

2. It is possible to include items whose manifest content is not obviously related to the attitude in

question, so that the subtler and deeper ramifications of an attitude can be explored.

Oppenheim (1966) has also commented that the most serious criticism leveled against this type of scale is its lack of reproducibility. The same total score may be obtained in many different ways. Often for this reason, the pattern of responses becomes more interesting than the total score.

Environmental Attitude Studies

To date very little research has been reported on environmental attitudes. That found which is pertinent to this study is briefly described below:

In a study involving elementary school children in an urban classroom, Trexler (1963) investigated the relationship between children's testimony and their observed behavior regarding conservation behaviors. He also examined the relationship between the consistency of the children's testimony and their intelligence quotient, their sex, their academic achievement, and the type of housing they lived in. He found that the correlation (.03) between what children testified they did and what they actually did was not strong enough to suggest that their test-

imony could be relied upon to ascertain their actual conservation behavior. Analyses of the data led Trexler to conclude that none of the personal factors tested could be shown to affect the consistency of the children's responses.

George (1966) reported a study designed to determine whether knowledge and understanding resulted in more favorable attitudes toward conservation. A Likert-type attitude scale related to conservation was used to make 1618 observations, representing three different age and educational levels: Group 1, 585 high school students; Group II , 462 college students; Group III, 571 adults. There were three phases to the study. First, the conservation attitude scores were compared for differences between the groups. Second, the scores were related to factors affecting conservation attitudes: personal characteristics, extracurricular activities, and 4H conservation projects. The third phase dealt with attitude change resulting from a special conservation education experience designed specifically for each group.

George found significant differences in attitudes among the three groups as indicated by a comparison of

the total mean scores. Of the four personal characteristics studied, age and education were associated with the most significant differences in attitudes of the high school students. The most significant characteristics in the college student group were age and sex, while sex and residency background were significant for the adults. Extra curricular activities with an apparent conservation emphasis, such as conservation clubs and nature camps, had the greatest positive effect in the development of conservation attitudes.

George found that attitudes toward conservation did change, that the changes were associated with interest motivation, and exposure to conservation knowledge, and that significant attitude change could be identified and associated with the special conservation educational experience designed for each of the groups.

Using five dimensions of environmental attitudes representing basic value-attitudes an individual would normally acquire during the natural acculturation process, Hoover and Schutz (1964) investigated whether differences in environmental attitudes existed between science and non-science majors in selected colleges

and universities throughout the country. The comparison of science and non-science majors was undertaken because environmental education has traditionally been handled within the province of science education.

Subjects consisted of 785 students of at least junior standing in 14 different colleges and universities during the 1962-63 school year. The students were divided into three major groups: 132 forestry majors, 260 science majors, and 393 non-science majors, most of whom were elementary education majors. A scale of 92 items constructed on the basis of the five dimensions was used. Each item presented a brief hypothetical situation to which the student recorded his approval or disapproval, using a five point Likert-type scale.

Hoover and Schutz reported that although analysis of variance indicated significant differences among the groups, the differences were so slight as to have no practical significance. From this they concluded that science education had little impact on basic environmental attitudes, and that the effect of college curricula upon modification of basic attitudes was far

from encouraging.

Steiner (1971) headed a study which involved: 1. The inductive development of a Likert-type attitude inventory to assess attitudes toward identified referents which are basic to specific societal issues such as pollution, population, and conservation, and 2. the assessment of the attitudes of a representative sample of Oregon high school seniors toward the identified basic attitudes. A randomly selected sample of Oregon high-school seniors was administered the preliminary inventory. The responses were factor analyzed to identify attitudes basic to the specific societal issues represented in the inventory. The factor analysis yielded seven interpretable factors consisting of 60 items. This instrument was called The Inventory of Societal Issues (ISI). The representative sample of Oregon high school students was classified as to the amount of science, school environment and sex. The students' scores on each of the factor attitude scales were used as dependent variables, and the students' classification as the independent variable in an analysis of variance. In addition, the science and non-science sub-groups were compared by Chi-

square on all items of the Inventory of Scoietal Issues. The amount of science, school environment and sex were found to be significant on three of the factors. The science and non-science groups were found to respond significantly different on 24 of the 60 items on the I.S.I.

Steiner concluded, however, that although many societal issues are science related, the amount of science a student took in high school did not result in attitudes significantly different from students who took a minimum of science.

In a study conducted by Yakimishyn (1973) a Likert-type instrument was used to measure the effect of The Environmental Concerns Program (sub project of Project Canada West) on changing students attitudes toward the environment. The instrument was designed by A. Watson and administered to a group of rural high school students. The scale administered on a pre and post test basis indicated that the environmental program significantly enhanced the environmental attitude of students who participated in the program.

Based upon the five studies reviewed it appears that:

1. The ability to identify or recognize environ-

mental problems does not necessarily imply knowledge or understanding of the problem.

2. Statements of behavior with respect to environmental concerns do not satisfactorily predict observed behavior consistent with such statements.

3. While attitudes favorable to environmental concerns are related to past experiences, there is little evidence to suggest that formal science education enhances these attitudes more than does education for the non-science major.

4. Some evidence does appear to suggest that positive attitude change is promoted by interest motivation and exposure to environmental education experiences.

CHAPTER III

DESIGN OF STUDY

The purpose of this chapter was to outline the design and methods of the experimental study. It will include a discussion of the sample, the treatment, the instrument, the experimental design, the procedures of the investigation and the hypotheses.

Description of Sample

This study involved three Ecology classes in the treatment group and two "Genetics and Evolution" classes in the control group at Vincent Massey Collegiate, Fort Garry, Manitoba. Table 1 illustrates the distribution of students by grade level and sex.

Table 1

Distribution of Students in Treatment and Control Group by Grade Level and Sex

Source	Gr.10 Male	Gr.10 Female	Gr.11 Male	Grade 11 Female	Gr.12 Male	Gr.12 Female
Treatment	16	8	15	12	4	15
Control	8	8	9	7	8	8

The general academic background, academic ability and course selection of the two groups was similar. All the grade 10 students had completed the first half of the Introductory Physical Science (IPS) course. The

Ecology course was the first exposure to a biology course at the high school level for the grade 10 students. It should be noted that the grade 10 students took the program voluntarily as an extra half-course.

Most of the grade 11 students had already completed one or two biology half-courses. Most of the grade 12 students had previously completed three biology half courses. The ages of both groups ranged from 15 to 18 years. Approximately 1/3 of the grade 11 and grade 12 students were taking, or had taken, a chemistry course and approximately 1/5 of the grade 11 and grade 12 students had taken, or were taking a physics course.

In order to determine whether or not the two groups were statistically equivalent, a Kolmogorov-Smirnov Two Sample Test using a .10 level of confidence was conducted using pretest environmental attitude scores. A maximum D value of .030 was obtained. The critical value at .10 level of significance is .233. The two groups, therefore, were considered to be statistically equivalent with regard to the environmental attitude variable.

Description of Treatment

The Ecology course introduced in Chapter one was designed to emphasize areas of relevance to en-

vironmental problems of modern society. The first portion of the course was devoted to a study of principles relating to the structure and function of ecological systems. The second part of the course examined major environmental problems in light of these principles. The general aims of the course were to develop in students:

1. Knowledge of basic ecological principles and the various factors (ecological, technological, cultural, economic) affecting decisions concerning environmental management.

2. Investigative skills to examine and evaluate alternative patterns of man's interaction with the environment.

3. An awareness of environmental concerns and the different values involved in resolving environmental concerns.

The basic course outline and approximate time spent on each unit was as follows:

Unit One - Basic Definitions and Meanings. Primary emphasis on ecosystems. (Ten hours.)

Unit Two - Energy. (Four hours.)

Unit Three - Succession. (Three hours.)

Unit Four - Biogeochemical Cycles. (Six hours.)

Unit Five - Populations. (Five hours.)

Unit Six - Man and Environmental Problems. (Fourteen hours.)

Unit Seven - Laboratory Exercises and Field Trips. (Ten hours.)

Reference to a more complete description of the course has already been made in Chapter one.

Description of Instrument

An Environmental Appreciation Survey (Appendix A) was constructed to measure student environmental attitudes. Since the development and refinement of the instrument used to measure environmental attitude was such a major component of the study a separate section of the thesis, Chapter four, was devoted to a discussion of the instrument.

Experimental Design

The study was conducted using a pretest, posttest design described by Campbell and Stanley (1966) diagrammed below in Figure 1.

FIGURE 1. Design of the Study

Experimental Group	Pretest	Treatment	Posttest
Control Group	Pretest	No Treatment	Posttest

In the research design, the control group and the treatment group did not have pre-experimental sampling equivalence. Rather, the groups consisted of naturally assembled classroom groups.

Procedures of the Investigation

1. Collection of data

In the design used both groups completed the Environmental Attitude Survey at the same period of time, prior to the beginning of the Ecology course. In the experimental group the students subsequently experienced the Ecology course. The control group did not receive the treatment, but at the conclusion of the Ecology course both groups again completed the Environmental Attitude Survey.

2. Analysis of data

As was stated earlier, attitude scales are relatively crude measuring instruments. It is essential to consider this when selecting the statistical method to be used in analyzing data obtained by the use of attitude scales.

Parametric techniques of statistical treatment make several assumptions about the scores being treated, one being that they are on an interval scale. This means that equal distances on the scale of scores

are equivalent to equal differences in the quantity being measured. This assumption cannot be made about a Likert attitude scale, as has been explained by Shaw & Wright (1967). The errors consequent upon using parametric techniques in such a situation have been examined at length by Siegel (1956) who stated that:

> When only the rank order of scores is known, means and standard deviations found on the scores themselves are in error to the extent that the successive intervals on the scale are not equal. When parametric techniques of statistical inference are used with such data, any decisions about hypotheses are doubtful. (Siegel, P. 26)

Bollen (1972) also suggested that:

> The most that can be assumed about two attitude scores is that the higher score represents a more favourable attitude, thus the measurements constitute an ordinal scale, and non-parametric methods must be used to compare samples. (Bollen P. 222)

A Kolmogorov-Smirnov Two Sample Test was used when comparing scores between two groups. A Kruskal-Wallis One-Way Analysis of Variance Test was used when comparing scores from students in grades 10, 11 and 12.

The investigation to this point has been concerned with total scores on the attitude scale. These scores were considered as representing an

overall environmental attitude. This total attitude, however, is composed of many separate attitudes or factors. The attitude scale as will be explained in the next chapter has been designed around 6 basic attitudinal factors. The general conclusions which can be made about attitudes and the effects of training need not, therefore, apply to each individual aspect of the total attitude.

The object of this section was to examine scores on the identified attitudinal factors, both before and after treatment, in order to make inferences on the attitudes toward the various factors. This was done for the treatment group as a whole and then by sex and grade level. A Kolmogorov-Smirnov Two Tailed Test was used to determine if any changes were significant.

Hypotheses

The following null hypotheses with numbers corresponding to the questions of Chapter one were tested.

Ho_1: There is no significant difference in environmental attitude between the treatment group which has completed the Ecology course and a control group which has not.

Ho_{2a}: There is no significant difference between students in grades ten, eleven and twelve in environmental attitude before receiving instruction in Ecology.

Ho_{2b}: There is no significant difference between students in grades ten, eleven and twelve in environmental attitude after completing the course in Ecology.

Ho_{2c}: There is no significant difference in environmental attitude between students in grades ten, eleven and twelve of the treatment group which has completed the Ecology course and the students in grades ten, eleven and twelve respectively of a control group which has not.

Ho_{3a}: The treatment group shows no significant difference in environmental attitude between the sexes before receiving instruction in Ecology.

Ho_{3b}: The treatment group shows no significant difference in environmental attitude between the sexes after receiving instruction in Ecology.

Ho_{3c}: There is no significant difference in environmental attitude between the males and females of the treatment group which has completed the Ecology course and the males and females respectively of a control group which has not.

Ho_{4}: The treatment group shows no differential change with respect to the total scale or to the factors of the environmental attitude, overall nor by sex or grade.

CHAPTER IV

DEVELOPING AND REFINING THE INSTRUMENT

Development

An attitude scale known as The Environmental Appreciation Survey (Appendix A) was constructed to measure student attitudes to the following factors that were selected as being central to the Ecology Course:

1. The importance of and the need for an environmental education movement in the schools.

2. The need to co-operate with nature rather than to subjugate it.

3. Concern for the problem of increased population and the implications or consequences of population increase and its control.

4. The need to take personal responsibility for current environmental problems.

5. The need to recognize the reality and seriousness of environmental problems.

6. The desire to have and allow individual freedom, re environmental issues.

Explanation of the Factors

Factor 1.

Measuring student attitudes to factor 1 is important. If a province wide ecology course is to be instituted the degree to which students perceive various aspects of ecology as educational concerns is critical. Three sub components of this factor can be identified.

(a) Degree of educational commitment to the environmental ethic.

(b) Relevance of ecology to other curricular areas.

(c) Importance attached to ecology as a specific discipline.

Factor 2.

Throughout the Ecology course, but more specifically in Unit one, man is shown to be a part of the ecosystem and the biosphere, and not as something outside of it or dominant to it. This was clearly expressed by Roger Peterson (1975) when he stated:

> We as humans are in nature, not separated from it. We are animals, subject to natural laws ---- We have come no closer than any other species to freeing ourselves of our dependence on air, water and protein. (Peterson, P. 92)

The significance of our attitudes toward this idea is conveyed by the basic assertion of Lynn White, Jr.'s (1964) article, "The Historical Roots of Our Ecological Crisis":

> What people do about their environment depends on what they think about themselves in relation to things around them. Human Ecology is deeply conditioned by beliefs about our nature and our destiny -- that is, by religion.
> (White Jr., P. 1205)

Factor 3.

Overpopulation is considered by many to be man's most fundamental problem. It is the one specific problem that underlies so many other environmental problems. Due to its prominence it was decided to measure the student attitudes toward it.

Factor 4.

This is designed to measure the degree to which students accept responsibility for current environmental problems.

Factor 5.

This is principally concerned with measuring the students attitude from the standpoint of awareness of environmental problems.

Factor 6.

This factor essentially is concerned with the de-

gree to which a student has formulated an internal value system related to environmental problems.

Method of Selection of Items

A large pool of approximately 120 Likert-type attitude items was constructed representing a myriad of specific societal issues that are related to the identified factors. The following criteria were used in the selection of the 26 items actually used in the instrument:

1. All statements should be expressions of desired behaviour or opinions and not statements of fact.

2. Each proposition is stated in clear, concise straightforward statements. Each statement should be in simplest possible vocabulary.

3. Each statement should be of such a nature that persons with different points of view will respond to it differentially.

Reduction from 120 Likert-type attitude items to the 26 appearing on the attitude scale was done by following the three criteria listed. Using these criteria the following system was used by the author:

1. Items were eliminated on the basis of ambiguities, unfamiliar terms, factual statements and consensus items.

2. Remaining items were separated into groups on the basis of the 6 identified factors.

3. Items were then selected as to those that seemed to best measure the factor.

4. Final item selection and number of items per factor were based on the relative importance given to each factor.

A panel of ten experts comprised mainly of biology teachers separated each of the 26 items into groups on the basis of the 6 identified factors, in order to measure the degree of agreement with the author's placement. The results are shown in Table 2.

Table 2 shows a wide range of percentage agreement scores. Some explanation for this range is necessary. Some aspects such as that of "individual freedoms" of factor 6 are difficult to approach in an abvious or direct manner as students are apt to be less than truthful about such an inherently sensitive issue. Care was taken by the author to select items in certain of the areas whose intent would

Table 2

Item Placement According to Factors

Factor	Author Placement of Items	Percentage of Agreement
1 (a)	20	70
	4	70
	8	50
	3	60
(b)	7	100
	21	100
(c)	10	70
	22	70
2	6	100
	12	80
	13	30
3	24	100
	26	100
4	17	40
	18	100
	25	50
5	1	50
	9	50
	14	70
	16	100
	23	100
6	5	30
	11	50
	15	100
	19	60

not be blatantly obvious. The value of this was pointed out by Oppenheim (1966) in a discussion of the advantages of a Likert-type scale when he stated:

> .... it becomes possible to include items whose manifest content is not obviously related to the attitude in question, so that the subtler and deeper ramifications of an attitude can be explored. (Oppenheim, P. 141)

One other important observation is that even on those items where there was generally low agreement with the author's placement, in no case was there as great an agreement between the experts as to which other factor the item best measured. (Appendix B)

The author recognized, however, the inherent problem of trying to isolate and measure one attitude from a considerable number of others to which it is linked and correlated and which, in their turn, may also be part of underlying value systems.

Refinement

The initial instrument was first administered on September 8, 1974, to 59 students (fall term pilot group) enrolled in three first semester Ecology classes and to 32 students enrolled in a first semester "Genetics and Evolution" class (fall term control group) at

Vincent Massey Collegiate. The scores obtained by pilot group were subjected to an item analysis by the "short cut" method often known as 27D and described in full by Ebel (1965). Item analysis can be used as an objective test to determine whether the members of a group react differentially to the statement in the same manner that they react differentially to the battery. Item analysis reveals the satisfactoriness of any statement so far as its inclusion in a given attitude scale is concerned.

The item analysis results for the Ecology students on the pretest is given in Appendix C.

The meaning of the two sets of indices found by the item analysis requires some discussion. If every student had marked a particular statement, "strongly agree", the relevant agreement index would have been 100 per cent. When looking for differences in attitudes, such a statement would have been valueless. Bollen (1972) suggested that an item having an agreement index greater than .90 should not be retained. On this basis none of the items would be eliminated.

The discrimination index shows how well a particular statement distinguishes between those students whose overall environmental attitude is most favourable and those whose attitude is least favourable. Thus it is a measure of internal consistency, giving a higher figure for those statements which contribute most to the distinction between the attitudes of different students. The determination of a borderline, below which the figure is judged to be too low, could lead to much discussion. It could be argued that any statement with a positive discrimination index is worthy of retention. The figure of 0.14 was suggested by Bollen.

On this basis items 1, 2, 7, 12 and 23 could be eliminated. It should be noted, however, that items 7, 12 and 23 showed a high level of item difficulty and corresponding low agreement index. It was decided to administer the instrument as it was, to the test group on a posttest basis and to repeat the item analysis. The posttest was administered to the same group on January 17, 1975. The

results of the 27D test are shown in Appendix C.

On the posttest item analysis, items 1, 7, 12 and 23 all had a discrimination index above 0.14. In fact, item 12 with a discrimination index of only 0.06 on the pretest is tied with item 15 as the most discriminating on the posttest with an index of 0.43. Item 5 and 24 which had relatively low agreement indexes and high discrimination indexes on the pretest are seen to have high agreement indexes and low discrimination indexes on the posttest. Item 2 was discarded as it did not meet Bollen's criteria on either pre or posttest.

Reliability of the Instrument

1. It was decided to use the test - retest method on a control group to check for the reliability of the instrument. A Botany class of 22 students from Vincent Massey Collegiate who had not taken Ecology, and who were not currently taking Ecology wrote the pretest in March, 1975, and the posttest four weeks later. The Spearman Rank Correlation Coefficient for the overall scale was .840.

2. As an additional measure of reliability, it was decided to check on the internal consistency of the scale. Correlation coefficients were calculated for each of the survey items. The results are shown in Table 3.

Table 3

Spearman Rank Correlation Coefficients of Pre and Post Survey Responses

Item Number	Correlation Coefficient	Item Number	Correlation Coefficient
1	.578	14	.758
2	(eliminated)	15	.422
3	.418	16	.812
4	.462	17	.479
5	.879	18	.650
6	.491	19	.742
7	.374	20	.815
8	.760	21	.828
9	.633	22	.689
10	.414	23	.742
11	.677	24	.894
12	.690	25	.531
13	.696	26	.750

Note: Critical value at .05 level for N=22 is .359

Validity of the Instrument

Item content and the method of selecting items provide a basis for validity. In addition to content validity the scale was shown to differentiate between a group of subjects who had taken Ecology (fall term pilot group) and a group (fall term control group) who had not taken Ecology. Largest difference between scores on the posttest obtained from Kolmogorov-Smirnov Two Sample Test was .478, which is significant beyond the .001 level of confidence.

It is assumed that the instrument also has predictive validity as the scores of the fall term pilot group changed in the predicted direction after the experimental treatment. Largest difference between scores on the pre and posttest obtained from Kolmogorov-Smirnov Two Sample Test was .419, which is significant beyond the .001 level of confidence.

Shaw and Wright (1967) have stated that predictive validity seems to be most important when one wishes to relate attitudes to actions.

CHAPTER V

RESULTS

The purpose of this study was to develop an instrument to assess environmental attitudes and use it to determine the effect of an Ecology course developed for use in the secondary school level. Four questions were generated from the study, and the answers to these questions as derived from the statistical analysis will be discussed. A complete list of pretest and posttest scores grouped by grade level and sex is shown in Appendix D.

Question 1. Does a course in Ecology have an effect on students' environmental attitudes?

To answer this question the following null hypothesis was tested:

> Hypothesis 1. There is no significant difference in environmental attitude between the treatment group which has completed the Ecology course, and a control group which has not.

A Kolmogorov-Smirnov Two Sample Test based on the posttest scores resulted in a D value of .255. Since the critical value at .05 is .187 the decision was to reject the null hypothesis.

A pretest comparison discussed in Chapter 3 indicated that the treatment and control group were

not significantly different at the .10 level of confidence.

An additional test to determine whether or not appreciable effects could be attributed to history and maturation was conducted. Pretest and posttest environmental attitude scores of the control group were compared for equivalence using a Kolmogorov-Smirnov Two Sample Test and a .10 level of confidence. A maximum D value of .127 was obtained. The critical value at .10 level of significance is .253, therefore the groups were considered to be statistically equivalent. The high confidence level was chosen to help give assurance of equivalence.

Question 2. Does grade level have an effect on students' environmental attitudes?

To answer this question the following null hypotheses were tested:

> Hypothesis 2a. There is no significant difference between students in grades ten, eleven and twelve in environmental attitude before receiving instruction in Ecology.
>
> Hypothesis 2b. There is no significant difference between students in grades ten, eleven and twelve in environmental attitude after completing the course in Ecology.

Hypothesis 2c. There is no significant difference in environmental attitude between students in grades ten, eleven and twelve of the treatment group which has completed the Ecology course and the students in grades ten, eleven and twelve respectively, of a control group which has not.

To test hypotheses 2(a) and 2(b) scores of students in grades 10, 11 and 12 on the pretest and then on the posttest were compared by using the Kruskal-Wallis One-Way Analysis of Variance. The results are shown in Table 4. A .05 level of confidence was used.

Table 4

Kruskal-Wallis
One-Way Analysis of Variance
for Grade Levels

Source	df	R. Values			H Value
		Grade 10	Grade 11	Grade 12	
		N=24	N=27	N=19	
Pretest	2	1095.0	651.0	739.0	14.50
Posttest	2	924.5	717.5	843.0	8.92

With reference to Table 4 an H value of 14.50 has a probability of occurrence under Ho of less than .001. The decision was to reject null hypothesis 2(a). An H value of 8.92 has a probability of occurrence under Ho of less than .02. The decision was to reject null hypothesis 2(b).

To test hypothesis 2(c) posttest scores of students in the treatment group in grades 10, 11 and 12 were compared with posttest scores of students in the control group from corresponding grade levels by using the Kolmogorov-Smirnov Two Sample Test. The results are shown in Table 5.

Table 5

Kolmogorov-Smirnov Two Sample Test Comparison of Posttest Scores of Students in Treatment Group and Control Group by Grade Levels.

Source	D Value	Critical Value
Grade 10	.312	.450
Grade 11	.467*	.435
Grade 12	.517*	.462

*significant at .05 level.

With reference to Table 5 the decision was to reject null hypothesis 2(c).

Question 3. Does the sex of the student have an effect on environmental attitudes?

To answer this question the following null hypotheses were tested:

Hypothesis 3a. The treatment group shows no significant difference

in environmental attitude between the sexes, before receiving instruction in Ecology.

Hypothesis 3b. The treatment group shows no significant difference in environmental attitude between the sexes after receiving instruction in Ecology.

Hypothesis 3c. There is no significant difference in environmental attitude between the males and females of the treatment group which has completed the Ecology course, and the males and females respectively of a control group which has not.

To test hypotheses 3(a) and 3(b) the test scores of the males and the females were compared first on the pretest and then on the posttest at the .05 level of confidence.

A Kolmogorov-Smirnov Two Sample Test resulted in a D value of .143 on the pretest and .171 on the posttest. The critical value is .292. The decision was to not reject null hypothesis 3(a) or null hypothesis 3(b).

To test hypothesis 3(c) posttest scores of males and females in the treatment group were compared with posttest scores of students in the control group of the corresponding sex using the Kolmogorov-Smirnov Two Sample Test. The results are shown in Table 6.

Table 6

Kolmogorov-Smirnov Two Sample Test Comparison of Posttest Scores of Students in Treatment Group and Control Group by Sex.

Source	D Value	Critical Value
Males	.379*	.345
Females	.340	.354

* Significant at .05 level

With reference to Table 6 the decision was to reject null hypothesis 3(c).

Question 4. Do attitudes as measured by the total scale or by the different factors which make up the environmental attitude scale change differentially overall or with respect to grade level or sex?

To answer this question the following null hypothesis was tested:

> Hypothesis 4. The treatment group shows no differential change with respect to the total scale or to the factors of the environmental attitude, overall nor by sex or grade.

To test this hypothesis factor scores were computed for each student. The distribution of the total scale scores and factor scores were tested for significance on a pretest posttest basis for the

Table 7

Kolmogorov-Smirnov
Two Sample Test Comparison of Pre-test, Posttest, Total Scale Scores and Factor Scores.

	Total Scale	Factors					
Source		1	2	3	4	5	6
Overall	.257*	.185	.271*	.114	.157	.186	.371*
Males	.343*	.343*	.257	.372*	.114	.143	.400*
Females	.286	.142	.285	-.086	.285	.257	.372*
Grade 12	.474*	.421	.263	.125	.158	.316	.526*
Grade 11	.445*	.259	.334	.445*	.334	.225	.482*
Grade 10	.333	.208	.208	.209	.083	.126	.375

* Statistic significant at .05 level.

Note: Critical values for .05 level are:

Overall (N=70) = .230 Grade 12 (N=19) = .441

Males (N=35) = .325 Grade 11 (N=27) = .370

Females (N=35) = .325 Grade 10 (N=24) = .393

Based on the data of Table 7, the decision was to reject hypothesis 4.

group overall, for the sexes, and the grade levels by means of the Kolmogorov-Smirnov Two Sample Test. The results for this hypothesis were treated at the .05 level of confidence. The results are shown in Table 7.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

Based on the results of the research undertaken this section will list and discuss conclusions.

1. The Ecology course was effective in developing positive environmental attitudes in students.

These results seem to indicate the Ecology course was effective in achieving one of its prime goals, that of improving environmental attitudes. This tends to confirm the findings of others (George, 1966; Yakimishyn, 1973) that attitudes can be improved by exposure to Ecology or Environmental Science. The instrument developed was also found to be effective in measuring student changes in attitude.

2. Grade level has an effect on students' environmental attitudes, both before and after the course in Ecology.

Since students of different grade levels had different attitudes even before Ecology instruction, posttest differences, by grade level, cannot be attributed to the course.

Inspection of the data from Table 5, Chapter 5, shows that the difference on the posttest of the

treatment group compared to the control group was not significant for the grade 10 students but was significant for the grade 11 and 12 students.

Inspection of the test scores shown in Appendix D indicate that even though the grade 10 students scored high on both the pretest and the posttest, the increase did not appear as great as for the grade 11 or grade 12 students. In fact, the grade 10 girls did slightly less well overall on the post-test than on the pretest. The fact that the grade 10 students did not improve by as great an extent as the grade 11 or grade 12 students would seem to indicate that the Ecology course was less effective in improving their attitudes, even though their eagerness and enthusiasm seemed to lead to high test scores. Much of the discussion and many of the assignments in the values area of the course would be more beneficial to students who were at least minimally "formal operational" than to those students who were "concrete operational".

This interpretation would assume that the grade 10 students, because of their generally lower age level, would contain a greater proportion of concrete

operational thinkers than the grade 11 or 12 students. Age level of high school students had earlier been found to be a significant factor by George (1966).

At least part of the reason for the comparatively smaller improvement of the grade 10 students could have been due to their having initially high attitude scores. They, therefore, had less room for improvement.

Finally, the grade 10 students, who generally had the least exposure to high school science courses, scored the highest on the pretest. This would tend to lend support to the work of Steiner (1971) who concluded that the amount of science a student took in high school did not significantly affect his attitudes toward the environment.

3. Students of different sexes do not differ in their environmental attitude either before or after instruction in Ecology.

However, when compared with control group students, boys had environmental attitudes which differed significantly from their counterparts in the control group, while girls did not. The actual

difference in D value between the boys and the girls though was small. Inspection of data from Table 7, Chapter 5, also indicates some differences due to the sex of the individual. The boys showed significant changes, for the total scale and for factors 1, 3 and 6, while the girls showed significant changes only for factor 6. As indicated earlier, the lack of significant changes for the girls seems largely due to the negligible change for the grade 10 girls.

These latter conclusions should be interpreted cautiously. The best interpretation of these results would seem to be that overall the sexes do not differ because when compared internally within the treatment group neither initial or final overall attitudes differ for the sexes.

These results are not surprising George (1966) has found fimilar results for high school students.

4. Students who have completed an Ecology course show a differential change with respect to a total environmental attitude scale and to the factors which make up the scale overall as a group and by sex and grade.

Only those changes that were significant will be discussed here. It should be noted first, however, that there is an inherent problem in any attempt to identify, isolate and measure individual components of an overall attitude. The fact that the overall scale was shown to be both reliable and valid does not necessarily indicate that the various components of the scale are by themselves reliable and valid measurements of an attitude component or factor. A further note of caution is that Table 7 shows the results of 42 separate Kolmogorov-Smirnov Two Sample Tests, this number of tests increases the probability that some of the results are significant simply by chance.

Factors 2 and 6 show significant change overall. The fact that students overall showed a significant improvement in their attitude to factor 2 is encouraging. The need to co-operate with nature rather than to subjugate it, is one of the most fundamental ideas in Ecology and in the final analysis may be the most important for man's future survival.

Factor 6, the desire to have and allow individual freedom, re environmental issues was significant in all categories with the exception of the grade

10 students. An inspection of the factor scores shown in Appendix E shows comparatively low values were obtained for this factor on both the pretest and the posttest. This indicates that the idea of relinquishing certain individual freedoms was not a popular one, a result not totally unexpected. The fact that this very basic notion of individual freedom showed the most significant change of all the factors was quite surprising. It is especially gratifying that the Ecology course had such an influence on student attitudes about such a basically unpopular idea.

The boys showed a significant change for factor 1, while the girls did not, the reasons for this were not obviously apparent. The sub-components of factor 1 were also analyzed for significant changes and factor 1(a) was found to be significant overall. Factor 1(a) appealed to a total educational commitment to the environment. This indicates an important shift in student rationalization of the basic educational function. This may reflect the general societal view of the fundamental function of the school system which is away from the unequivocal commitment to universal

literacy into the present period of doubt, hesitation and reappraisal.

Inspection of the scores for factor 3 (Appendix E) shows that the girls generally had high scores on the pretest and posttest. The boys, and particularly the grade 11 students, scored poorly on the pretest and significantly higher on the posttest. This would seem to indicate that boys initially were not as aware as the girls about the problems associated with a rapidly increasing world population.

The control group as discussed in Chapter 5, was shown to be equivalent as measured by the pretest and posttest. Therefore, history and maturation were not an important factor over the treatment period and the significant changes shown in Table 7 can be considered to have been due to the Ecology course.

Implications for Educational Practise

The major implication of this study is that an Ecology course of the type used can bring about a significant improvement in the environmental attitude of high school students, as measured by the instrument designed for this study. Solution of present and future problems of environmental quality and sus -

tained use of resources requires an ecological awareness by young people. The school system generally must accept the challenge of educating the young people in this regard.

It is very important in this time of rapid change in education that attempts be made to measure the effectiveness of new programs. The instrument designed for this study was shown to be capable of measuring the effect of the Ecology course on student attitudes.

The fact that initial attitudes of students in the various grade levels were different suggests that the groups might benefit most from different approaches to instruction. For example, those showing high scores on the pretest might benefit most from a more rigorous content approach with less emphasis placed on values.

In the values clarification area there would seem to be a benefit in heterogeneous grouping for Ecology classes, where for purposes of discussion and group work students who score high on the attitude scales could be grouped with students who scored less well, in order to promote real growth

in the affective domain.

Recommendations for Future Research

Based upon this research and a review of the literature, it is clear that several problems require further research. The following areas are recommended:

1. Development and research on the effectiveness of teaching activities appropriate for conveying the various environmental concepts and principles to the different needs of students over a range of grade levels should be conducted.

2. Development and research on procedures for combining environmental concepts with the social sciences, sciences, and humanities in order to achieve environmental understanding should be conducted.

3. Longitudinal research in order to determine whether the environmental attitude changes are lasting should be conducted.

4. Research into the development of an instrument that has proven reliability and validity at the factor or attitudinal component level should be conducted.

BIBLIOGRAPHY

Allen, Rodney F. Teaching Guide for the Plover Books, Winona, Minnesota. Plover Books, 1974, 37-42.

Bollen, F. A. "Attitude Assessment in Science Teaching". School Science Review, December, 1972, 222-224.

Campbell, Donald I. and Stanley, Julian C. Experimental and Quasi Experimental Designs for Research. Chicago: Rand McNally & Co., 1966. 13.

Ebel, R. L. Measuring Educational Achievement. Toronto: Prentice Hall, 1965, 347.

George, Robert W. "A comparative analysis of conservation attitudes in situations where conservation education is a part of the educational experience." University Microfilms, Ann Arbor, Michigan, 1966.

Grant, Norris and Renner, John W. "Identifying Types of Thought in Tenth Grade Biology Students." Biology Teacher, May 1975, 283.

Hoover, Kenneth A. and Schutz, Richard E. "Conservation Attitudes of Science Majors as Compared with those of Non-Science Majors." Journal of Research in Science Teaching, 1964.

Knapp, Clifford E. "Attitudes & Values in Environmental Education." The Journal of Environmental Education, 1972, 3 (4), 26-29.

Kohlberg, Lawrence, "Stage and Sequence: The Cognitive Development Approach to Socialization." Handbook of Socialization Theory and Research. Chicago: Rand McNally and Company, 1971, 180-197.

Krathwohl, D. R., Bloom, B. S., and Masia, B. B., Taxonomy of Educational Objectives: Handbook II

The Affective Domain. New York: David McKay Company, Inc., 1964, 176-185.

Kuhmerker, Lisa, "We Don't Call It Moral Education: American Children Learn About Values." Journal of Moral Education, October 1973.

Oppenheim, A. N. Questionnaire Design and Attitude Measurement. New York: Basic Books Incorporated, 1966, 109, 121, 140, 141.

Peterson, Roger Tory, "Man's Role in Nature." Biology Teacher, 37 (2), 92.

Piaget, Jean, The Psychology of Intelligence. New York: Harcourt Brace, 1950, 6.

Rokeach, Milton, Beliefs, Attitudes, and Values. San Francisco: Jossey-Bass, Incorporated, 1968, P. 117.

Shaw, Marvin E. and Wright, Jack M., Scales for the Measurement of Attitudes. New York: McGraw-Hill Book Company, 1967, 2, 563-564.

Shymansky, J. and Matthews, C. "A Comparative Laboratory of the Effects of Two Teaching Patterns on Certain Aspects of the Behavior of Students in Fifth Grade Science." Journal of Research in Science Teaching, 1974, 11 (2) P. 157.

Siegel, Sidney, Nonparametric Statistics For The Behavioral Sciences. Toronto's McGraw-Hill Book Company, Inc., 1956, 26.

Steiner, Robert L. "Attitudes of Oregon High School Seniors Toward Some Environmentally Oriented Science Related Social Issues." Science Education, 1973, 57 (4) 417-436.

Superka, Douglas, "Approaches To Values Education." Social Science Education Consortium Newsletter, 1974, 20.

Swanson, Carl P., "The Role of the Humanities In Environmental Education." Biology Teacher, February 1975, 85.

Trexler, Clarence R. "A Study of the Relationship Between the Recorded and the Observed Conservation Behavior of Children in an Urban Classroom." Science Education, 1963, 47 (2) 144-156.

White, Lynn, Jr. "The Historical Roots of Our Ecological Crisis." Science, 155 (3767), 1205.

Yakimishyn, M. P. "Analysis of Pre and Posttest Scores for Environmental Concerns Attitude Scale." Canadian Environmental Concerns, Winnipeg: Project Canada West, 1-8.

APPENDIX A

DESCRIPTION OF INSTRUMENT

Environment Appreciation Survey

Place a check mark beside the appropriate response.

1. Sex Male ____ Female ____
2. Grade Level 10____ 11____ 12____
3. I am currently taking the course. ____

   I have taken the Ecology Course. ____

   I have not taken the Ecology Course ____

State the extent of your agreement with each of the following statements by circling the appropriate letter on the right side of the page according to the following criteria.

strongly disagree---- a
disagree ---------- b
uncertain ---------- c
agree ---------- d
strongly agree ------ e

	Rating
1. Ecology is very important in this scientific age in which we live.	a b c d e
2. I am always interested in learning more about the environment.	a b c d e

APPENDIX A (continued)

		Rating
3.	I have no interest in Ecology at all.	a b c d e
4.	An understanding of the environment and man's relation to it should be the most fundamental of educational objectives.	a b c d e
5.	Industry should package goods in throw away containers because they are convenient for consumers.	a b c d e
6.	Man must compete with nature to survive.	a b c d e
7.	The environmental approach is relevant to most subjects.	a b c d e
8.	Ecology should be a required course program for all high school students.	a b c d e
9.	Ecology is unrelated to life experiences.	a b c d e
10.	Ecology is not as important as other subjects.	a b c d e

APPENDIX A (continued)

	Rating
11. Mass public transportation systems should be developed.	a b c d e
12. Economic gain and advancement is the rightful use of the land and its wealth.	a b c d e
13. Ecological rather than economic considerations should be of prime importance in implementing large scale environmental projects.	a b c d e
14. Pollution, ecology and environmental management are overplayed topics by the media.	a b c d e
15. We should be forced to give up some of our imagined freedoms, such as the right to drive a car anywhere at any time.	a b c d e
16. Air pollution is no real problem because of the cleansing effect of the wind.	a b c d e

APPENDIX A (continued)

		Rating
17.	It is essential that everyone know the basic facts about ecosystems.	a b c d e
18.	There is very little that I myself can do to help the pollution problem in my area.	a b c d e
19.	The cost of disposing of a car should be included in the original purchase price of that car.	a b c d e
20.	Ecology is boring.	a b c d e
21.	Environmental problems should be considered in subjects other than ecology where practical.	a b c d e
22.	Ecology seems to be over my head.	a b c d e
23.	Pollution control is an issue in the 1970's and will be replaced by a more pressing issue in the 1980's.	a b c d e
24.	Population control should be of major concern to all governments.	a b c d e

APPENDIX A (continued)

	Rating
25. I often discuss major environmental issues with my fellow students.	a b c d e
26. Family planning should only be necessary in countries with large populations and poor economic conditions.	a b c d e

APPENDIX B

PLACEMENT OF ITEMS ACCORDING TO FACTORS BY EXPERTS

Factor	Item Number	Frequency	Factor	Item Number	Frequency
1(a)	2	7	1 (c)	10	7
	4	7		22	7
	20	7		1	3
	3	6		2	3
	8	5		4	3
	10	3		8	3
	17	3		17	3
	22	3		13	2
	25	3		25	2
	5	2	2	6	10
	1	1		12	8
1(b)	7	10		13	2
	21	10		5	2
	9	3		11	2
	8	2	3	24	10
	1	1		26	10
	13	1		11	3

APPENDIX B (continued)

Factor	Item Number	Frequency	Factor	Item Number	Frequency
4	18	10	5	14	7
	25	5		1	5
	3	4		9	5
	17	4		13	2
	19	4		5	1
	14	3	6	15	10
	12	2		19	6
	5	2		11	5
	9	2		5	3
5	16	10		13	1
	23	10			

APPENDIX C

27 D TEST FOR ITEM ANALYSIS

	Pretest		Posttest	
Statement No.	Agreement Index %	Discrimination Index	Agreement Index %	Discrimination Index
1	85	.08	86	.19
2	72	.13	75	.12
3	81	.20	81	.34
4	70	.14	79	.25
5	77	.33	93	.09
6	63	.36	80	.26
7	64	.13	69	.18
8	54	.17	60	.41
9	77	.22	90	.18
10	69	.22	76	.28
11	59	.22	67	.25
12	47	.06	67	.43
13	75	.31	80	.26
14	70	.31	81	.32
15	46	.33	52	.43
16	73	.34	86	.28
17	61	.28	67	.40
18	71	.20	77	.16

APPENDIX C

27 D TEST FOR ITEM ANALYSIS

	Pretest		Posttest	
Statement No.	Agreement Index %	Discrimination Index	Agreement Index %	Discrimination Index
19	48	.36	64	.22
20	64	.22	76	.28
21	70	.20	76	.28
22	66	.33	67	.31
23	53	.03	63	.28
24	77	.22	92	.04
25	46	.20	55	.37
26	60	.14	67	.51

APPENDIX D

TREATMENT GROUP TEST SCORES

Source	Pretest	Posttest
Grade 10 Males	80 78 78 76 73	84 83 82 82 81
	73 71 71 71 70	80 79 77 76 76
	70 69 68 66 65	74 71 70 66 64
	62	63
Grade 10 Females	74 73 72 72 67	85 79 73 66 62
	63 55 51	58 51 44
Grade 11 Males	75 74 70 66 61	77 75 74 74 70
	59 58 57 57 57	69 68 67 66 66
	56 56 55 42 27	64 63 60 59 58
Grade 11 Females	77 69 62 62 61	85 83 80 72 69
	61 58 57 57 56	67 64 62 61 59
	55 53	57 56
Grade 12 Males	83 70 64 62	82 78 75 75
Grade 12 Females	84 80 76 74 72	87 85 85 82 80
	71 70 68 65 64	78 78 75 72 71
	59 56 55 51 47	69 64 62 62 71

APPENDIX E

FACTOR SCORES

Source	Factor 1 Pretest	Factor 1 Posttest
Grade 10 Males	24 24 22 22 21	27 25 23 23 22
	21 20 20 19 18	22 22 22 21 21
	18 18 18 18 18	20 20 19 18 17
	17	17
Grade 10 Females	21 21 20 20 19	23 21 21 18 16
	19 12 12	14 12 10
Grade 11 Males	23 21 21 18 17	24 23 21 20 20
	17 17 17 17 17	20 19 19 18 18
	15 14 13 12 10	17 17 16 15 15
Grade 11 Females	22 22 19 17 17	26 25 21 20 19
	16 15 15 15 14	18 17 17 15 14
	12 12	12 12
Grade 12 Males	23 21 18 17	25 24 22 22
Grade 12 Females	27 24 23 21 20	27 26 26 23 22
	20 20 20 18 18	22 22 20 20 20
	18 18 17 14 14	20 19 19 18 17

APPENDIX E (continued)

Source	Factor 2 Pretest	Factor 2 Posttest
Grade 10 Males	12 11 11 10 10	12 12 11 11 10
	10 10 9 9 8	10 10 9 9 8
	7 6 6 5 5	8 8 7 7 7
	4	4
Grade 10 Females	11 10 9 8 6	12 9 8 8 7
	6 5 5	6 6 5
Grade 11 Males	9 9 8 8 8	10 10 10 9 8
	8 8 6 6 5	8 8 8 7 7
	5 5 5 4 4	7 6 6 5 3
Grade 11 Females	11 8 8 7 7	10 10 10 9 8
	6 6 5 5 5	8 8 8 8 7
	4 3	6 6
Grade 12 Males	10 8 7 5	11 9 7 7
Grade 12 Females	12 11 11 9 8	12 12 11 11 10
	8 8 8 7 6	9 9 8 8 8
	6 6 6 5 4	8 8 7 6 4

APPENDIX E (continued)

Source	Factor 3 Pretest					Posttest				
Grade 10 Males	8	8	8	8	8	8	8	8	8	8
	8	7	7	7	7	8	8	8	8	7
	7	7	5	5	4	7	7	7	7	6
	4					4				
Grade 10 Females	8	8	7	7	7	8	8	8	8	7
	7	6	5			5	4	3		
Grade 11 Males	7	7	6	6	6	8	8	8	7	7
	5	4	4	4	4	7	7	6	6	6
	3	3	3	3	0	6	6	6	5	4
Grade 11 Females	8	8	8	8	6	8	8	7	6	6
	6	6	6	6	6	6	6	6	6	6
	6	4				3	3			
Grade 12 Males	8	6	3	3		7	6	6	4	
Grade 12 Females	8	8	8	8	8	8	8	8	8	8
	8	8	7	7	6	8	7	7	6	6
	6	4	3	3	2	6	4	4	3	2

APPENDIX E (continued)

Source	Factor 4 Pretest					Posttest				
Grade 10 Males	10	9	9	9	8	10	10	9	9	9
	8	8	8	8	7	8	8	8	8	8
	7	7	7	6	6	7	7	7	6	6
	5					5				
Grade 10 Females	10	9	8	7	7	10	9	8	8	7
	5	5	5			6	6	5		
Grade 11 Males	10	9	8	7	7	9	9	9	9	8
	7	7	7	6	5	8	8	7	7	6
	5	5	4	4	3	6	6	5	4	3
Grade 11 Females	9	8	6	6	6	11	9	9	8	8
	6	6	6	5	5	7	7	7	7	7
	5	5				5	3			
Grade 12 Males	9	9	9	7		10	10	7	6	
Grade 12 Females	10	9	9	8	8	11	10	8	8	8
	8	7	7	6	6	8	8	7	7	7
	6	6	5	4	2	6	6	6	6	4

APPENDIX E (continued)

Source	Factor 5 Pretest	Posttest
Grade 10 Males	20 18 18 18 18	20 19 19 19 18
	18 18 17 16 16	18 18 17 16 16
	16 16 15 14 13	16 15 14 14 14
	13	14
Grade 10 Females	16 15 15 15 14	18 17 16 16 15
	13 13 12	13 10 10
Grade 11 Males	18 18 17 17 16	18 18 17 17 16
	15 15 15 15 15	16 16 16 15 14
	15 13 13 9 5	14 14 13 12 12
Grade 11 Females	18 16 15 15 15	20 18 17 17 16
	15 15 14 14 14	16 15 15 14 13
	13 13	11 11
Grade 12 Males	20 18 15 13	20 19 18 17
Grade 12 Females	20 19 18 18 17	20 19 19 18 18
	17 16 15 14 14	18 17 17 16 15
	14 14 13 13 12	15 15 15 14 13

APPENDIX E (continued)

Source	Factor 6 Pretest	Posttest
Grade 10 Males	13 13 13 10 10	14 13 13 13 12
	10 10 9 9 9	12 12 12 11 11
	8 8 8 8 7	11 9 8 8 8
	5	6
Grade 10 Females	12 11 11 10 9	12 12 11 11 10
	8 8 8	7 6 5
Grade 11 Males	12 11 10 9 9	13 13 12 12 11
	9 8 7 6 6	11 10 10 10 10
	6 5 5 3 3	9 9 7 6 2
Grade 11 Females	11 11 11 10 9	13 13 12 12 11
	9 9 8 8 8	11 11 10 10 9
	6 2	9 8
Grade 12 Males	11 10 9 9	13 12 10 10
Grade 12 Females	14 13 12 10 10	16 14 14 14 13
	9 9 8 6 6	12 11 11 11 11
	6 6 5 3 1	10 10 9 9 8