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An investigation into environmental attitudes of sixth grade earth science students

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Abstract

"Environmental education is at a new crossroads in its evolution. Environmental educators all want to save this p 1 a net from tot a 1 human destruction." 1990).

THE UNIVERSITY OF NORTHERN IOWA

AN INVESTIGATION INTO ENVIRONMENTAL ATTITUDES OF SIXTH GRADE EARTH SCIENCE STUDENTS

A RESEARCH PAPER SUBMITTED
IN PARTIAL FULFILMENT
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WRITTEN BY

RICHARD J. STOUT
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INTRODUCTION

STATEMENT OF THE PROBLEM

"Environmental education is at a new crossroads in its evolution. Environmental educators all want to save this planet from total human destruction." (Tudor, 1990).

In the years before the advent of Earth Day in 1970, and the environmental education movement, conservation education was the manner in which stewardship was addressed in our nation's schools. These curricula were designed to teach awareness, appreciation, and wise use of natural resources. Soil, water, forest, and wildlife conservation became topics that were taught as separate units. Little was done to promote a perspective that helps one see the relationships that exist between nature and the human population. These units typically focused on cognitive objectives emphasizing natural resource utilization. Stapp (1970) reported, "Most current programs in conservation education are oriented primarily to basic resources; they do not focus on the community environment and its associated problems. Furthermore, few programs emphasize the role of the citizen in working, both individually and collectively, toward the solution of problems that affect our well-being. There

is a vital need for an educational approach that effectively educates man regarding his relationship to the total environment."

Earth Day, April 22, 1970, saw a generation dedicate itself to reclaiming the planet. As a result of the emerging awareness, brought about in part by Earth Day, educators from around the nation discovered that despite the growing interest and concern for our environment, very few school curricula made provisions for environmental education, (Stanton, (1971). In addressing this need, Stapp (1970) summarized the opinions of many when he announced, "If individuals are to be prepared to make the kind of environmental decisions that our nation will face in the future, schools must embark on a comprehensive environmental education program that will span the curriculum from kindergarten through the twelfth grade. It must link subject areas that relate most closely to the environment." So as the 70's began, environmentalism was receiving much expanded and more intensive attention. The direction of the curriculum design, that is, whether it should be addressed to the cognitive or affective domain, was still undecided.

As a result of the growing national concern toward an environmental ethic, Congress, in 1970, passed into law the Environmental Education Act (P.L. 91-516). This

act provided funding for environmental curricula development. This law encouraged the development of new curricula designed to encourage knowledge of environmental policies. It funded the writing of instructional activities that were designed to enhance environmental quality. One of the major impacts of P.L. 91-516 was to define environmental education and to accept national policy status for it. Another aspect of Public Law 91-516 was to help disseminate information for use in educational programs throughout the nation. After viewing a summary of P.L. 91-516, the writer of this research noted that cognitive gains appeared to be the major focus of those individuals entrusted with the writing of environmental education curricula.

In the score of years since the first Earth Day, the scope of environmental curricula has moved away from cognition-only programs of study. Replacing the knowledge-only approach is a curriculum design adapted by the National Science Foundation (N.S.F.). Recently, the N.S.F. conducted a nation-wide search for environmental education programs that fit their criteria for excellence. The criteria included curricula which developed creativity and critical thinking, encouraged alternative solutions to environmental issues, and allowed the learner to grow from awareness and

understanding, to concern and action. In addition, the N.S.F. criteria included fostering of open minds, stimulation of creativity, respecting the developmental maturity of learners, and providing opportunities for learners to be involved in environmental activity at an appropriate level of challenge, all these new programs were aimed at fostering an attitude that individuals can affect the environment, (Stoner, Padalino, and Purdy, 1987.)

Currently, both domains, affective and cognitive, appear to be crucial to a quality environmental program. Current environmental curricula include action as well as knowledge, feelings and attitude formation as well as information gathering.

The desire to encourage environmentally responsible attitudes has been on-going for many years in our nation's schools. However, little has been done to actually measure attitude changes. As a result, this teacher-investigator became curious as to whether participation in an Environmental Education unit would have a measurable effect upon the attainment of environmental attitude gains. For the purpose of this study, environmental attitudes will be defined as "people's relationships with each other and with their natural and altered surroundings which includes the

relation of population, pollution, resource allocation and depletion, conservation, transportation, technology, and planning to the total human environment." (Clausen and McCalley, 1978).

The purpose of this research is to measure the effects of an eight-week Environmental Education unit on the attitudes of sixth grade Earth Science students.

HYPOTHESIS

The directional research hypothesis of this study is as follows: There is a positive and statistically significant difference between pretest and posttest attitude scores of sixth-grade students who have participated in an eight-week unit devoted to Environmental Education.

IMPORTANCE OF THE STUDY

Research suggests that a significant amount of environmental attitudes are formed in elementary school years (Miller, 1981). He found that fifth-graders, for example, are still forming their environmental attitudes, while eighth-graders' attitudes are more stable and do not differ significantly from the general adult population. As this investigator teaches students who, according to research are at the age where they are still forming their environmental credos, more information concerning the formation of environmentally appropriate attitudes is of utmost importance.

Few of the studies in Iozzi's (1984) research determined the effects of specific programs designed to alter existing attitudes and the way they impacted the environment. He noted that the majority of the

environmental education research has lacked the rigor needed and expected in scholarly research. He continued by adding the perception that environmental education is a young and emerging area, and additional research is quite valuable.

The importance of this study centers on determining if environmental attitudes can, in fact, be positively influenced by engaging students in a series of activities designed to increase their awareness of environmental issues. These activities encourage students to interact with key environmental topics. For example, an activity on water usage allows the students to determine their needs respective to water. They generate lists that describe their water needs, then investigate how they could best use this limited resource while keeping pollution and waste at a minimum. Producing posters, poems, and other media gives students the freedom to explore environmental issues that pertain directly to them, while acquiring their personal environmental attitudes.

As stated, the activities presented in this unit allow students the freedom to fit the issues addressed and their particular responses to them into their own lifestyles. After the relationships between the curriculum and the attitudes that emerge from it are

examined, appropriate curricular changes will, hopefully, enable the students to become even more environmentally responsible citizens.

LIMITATIONS

All studies contain limitations. This study is no exception. The limitations that follow are, perhaps, not of major proportions, but are worthy of mention.

A 'Groundwater' (geology and water quality) segment of the course being studied had typically been used to introduce the students to the environmental education focus of the class. From that point, however, each class was allowed to choose from a list of issues to determine their next topic to investigate. As a result, responses on the "Attitude Survey" (See Appendix B) may be affected since it was not devised to reflect differences in the issues covered.

The survey form contained pictures of animals in the margins. Such a portrayal might produce responses of higher environmental appropriateness by influencing the children to select responses consistent with the context created by these pictures.

This survey was issued to students during school year 1990-1991. During the spring of 1991, local implementation of mandatory solid waste recycling raised

the awareness of many area citizens. Within this same time period, a public controversy arose as to whether or not to drill a new well in Anamosa. As part of the class, we discussed these issues. Local media presented information and opinions concerning whether or not the well was necessary. The media may have increased family and community discussions on these issues and served to reinforce class discussion. Out of class discussions and topic exposure may have had an effect upon the students' environmental attitude scores by raising their awareness of the issues and their level of concern.

The gender balance in the sixth grade being investigated was not even. The ratio of males to females was approximately 2:1. This imbalance may have an effect upon the outcome of the environmental attitude changes being studied.

The survey instrument was read orally by the teacher to the students. Unintentional bias could have emerged in the teacher's voice tone and pitch. The survey was read to assist the special education students who had been mainstreamed into regular education classes. Each of the special education students had difficulty in reading. If teacher bias was introduced, results could have been skewed.

Four of the 100 students surveyed were mainstreamed from special education programs into the study population. Multi-categorical and behavior disorder students are often impulsive. These students may have used the responses to show displeasure with the classroom situation and falsify their true environmental attitudes in the process.

The students were informed that the survey was an ungraded document. However, some students may have tried to please the teacher with their responses, even though they were informed that they were to state their true opinions. The time period between the pretest and post tests for each of the four groups was eight weeks. During this length of time it might be expected that students would alter their opinions on many topics, the environment being but one of many concerns of pre-adolescents. Attitude changes may or may not be confined to, or totally attributed to this unit of study.

On the last day of each eight week Earth Science class the students were given an identical survey. At this time, the students were read the following, "On the first day of class I gave each of you a survey that included thirty items. Today, the last day of class, I am going to give you another copy of the same survey. We are interested to see if your opinions and attitudes have

changed or not. Please answer honestly." These instructions may have caused the participants to feel they were being expected to alter their attitudes councerning the environment.

REVIEW OF LITERATURE

After reviewing the literature published on the topic of environmental attitude formation since the first Earth Day in 1970, it was apparent that there are three separate and distinct groups of theorists who advocate different approaches to maximizing environmental attitude formation. One group of theorists maintain that a cognitive-based approach is superior to an environmental attitude formation approach. A second group argues that a combination affective-cognitive approach is most beneficial in promoting environmentally appropriate attitudes. The third cluster of theorists encourage an affective-based curriculum to most effectively produce environmentally responsible attitudes.

Some environmental theorists embrace cognitive curricular designs. This traditional approach is designed to increase knowledge in a particular area. Textbook, worksheet, workbook, and lecture are some of the tools of a cognitive-based approach. Alaimo and Doran (1982) concluded that junior-high student self-perception of concern about environmental problems, chances of solving them, likelihood of participating in problem solutions, and knowledge of environmental problems and values were influenced little by affective

environmental instruction. Traditional thinking in environmental education has maintained that we can create responsible environmental attitudes by making students more knowledgeable about the environment.

In another study (Collins, 1978) found that educators who have called attention to the need for environmentally appropriate attitudes need to supply their students with a base of environmental principles, which will then lead directly to the establishment of new attitudes. In addition, Collins concluded that children acquire these principles easily when activities are incorporated.

Shafer (1976) professed a need for a cognitive view to develop an understanding of the biosphere. He advanced the idea that environmental education would profit from thinking in terms of systems. With this particular perspective, a student would be expected to fully understand all the principles of an ecosystem. The focus then, would be to understand the biosphere, then relate it to the students' own lives.

In reviewing the literature, some studies take a position of compromise in the cognitive versus affective issue. In one study, Ramsey and Rickson, (1976) supported the compromise view that knowledge and attitudes have a 'circularity', in other words, one harbors an increase in

the other. Iozzi (1982) found environmental education programs highly effective in increasing cognitive achievement and moral/ethical reasoning about issues. Schaefer (1978) also saw a need for both cognitive and affective approaches to teaching about the environment. He believed that understanding of our biosphere requires a full understanding of an ecosystem. He saw a need for a cognitive based curricula, but one also based on attitudes. He stated that 'environmental education must aim for the heart, not just the brain.' Thus he asserts that to gain a more reponsible environmental attitude, one must obtain information concerning the environment, and then act on that knowledge. This may be done through action-oriented projects that involve informing students of actual environmental problems and then engaging them in the resolution of these problems. An example of such an activity might include teaching students about the pollution of our groundwater by the over-fertilization of agricultural fields. Students could then brainstorm methods to reduce the problem locally. Another process incorporating both domains includes the neutral approach which involves approaching issues without a pre-determined bias. In this approach the classroom is a forum where all points of view are heard.

Other studies support this dual approach position. Holtz, (1976) in a study of naturalists working to increase appropriate environmental attitudes claims that just as students cannot be expected to do better academically when we teach attitudes, neither can students be expected to learn new attitudes merely as by-products of academic teaching. Environmental naturalists seem to be very aware that it is important to expose children to environmental attitudes along with environmental concepts if their programs are to have much effect. To change attitudes, specific activities must be included in the program. An example of this philosophy could be illustrated in the following activity; a lecture concerning the value of predators in the balance of nature is conducted, followed by a discussion of the frustration land-owners sometimes face due to the destruction predators do to livestock, as well as addressing the fears many have of animals that hunt for their existence. A summation of different points-of-view is then presented. To conclude this activity, a visit to a nearby raptor center would show the procedures necessary for rehabilitation of a sick or injured eagle. This type of environmental education typifies a composite approach that blends the cognitive and affective domains.

A curriculum based in the affective domain has, by definition, been designed to influence student feeling and emotion. Activities, rather than lecture, form the basis for an affective curriculum. Iozzi (1984) researched the number of studies in environmental education carried out between 1971-1981 designed to compare affective and cognitive teaching approaches. He found, surprisingly, that in the environmental education arena the affective domain prevailed. A total of 57.7% of the environmental education programs were concerned primarily with the affective domain. Only 41.1% of the programs were concerned primarily with the cognitive domain. He continued by adding that most research in other academic areas found the instructional focus was placed in the cognitive rather than the affective domain.

Charles (1985) in describing Project WILD, an environmentally-based curriculum, stated that she, "completely and enthusiastically supported what has been called an activities-oriented approach to environmental education." Research has shown, Charles continued, that after several Project WILD activities, statistically significant learning takes place. Finally, Charles concluded, that research indicates that the more instructional activities a teacher uses, the greater gain in student learning takes place. These activities can

take many forms. Among them are simulations, role-playing, field trips, guest speakers, case studies, moral dilemmas, local issues, and action projects. New findings indicate that environmental issues must be the focus of instruction. This goes far beyond environmental sensitivity, ecological foundations and issue awareness (Hungerford and Volk 1990). This position is shared by Alaimo and Doran (1980). In their study, lecture and textbook (cognitive-based) science classes did not have a positive effect on students' attitudes. In fact, during their two-year study, some students developed negative attitudes about the environment and environmental quality. The author believed that this outcome could be attributed to the students' greater knowledge of environmental problems contributing to a pessimistic view about today's lack of environmental quality.

The theorists who favor an affective approach to achieve a responsible environmental attitude operate in direct contrast with those who favor a combination cognitive-affective, or a traditional cognitive approach. An interesting study might arise from researching whether student attitude levels would change after participating in an Environmental Education unit that utilized affective domain approaches. Another factor that could be investigated is gender. Does one gender enter an

Environmental Education unit with more appropriate attitudes than another? Does participating in an eight-week Environmental Education unit affect scores of one gender more than another? A study (Borden and Schettino, 1979) reported that females show more "verbal commitment" to the environment than males. Another study, Hounshell and Liggett (1973) concluded that females demonstrated a more responsible attitude toward the environment than males.

METHOD OF THE STUDY

BACKGROUND OF THE STUDY

As an undergraduate student at the University of Northern Iowa from 1968-1972, the writer of this research paper experienced the first Earth Day. The deteriorating condition of the Earth's environment had become a nation-wide concern. Several friends chose to participate in Earth Day activities. Other friends passed the opportunity by. Why? What was the basis for their lack of interest and willingness to participate in such activities?

While working with elementary children, the same chasm appeared. Many students gladly gave up recesses to recycle paper and weekends to plant trees, while other youngsters had no desire to participate. Both groups of students received the same instruction. Each child was being presented ideas, activities, and facts designed to encourage them to nurture the Earth. If cognitive-based instruction and activities being used were not developing responsible attitudes for the environment, then perhaps the curriculum needed to be altered.

The curriculum that is now being used in Anamosa's 6th grade Earth Science classes was developed by the

author of this research, under the guidance of Bernard Clausen, Associate Professor at U.N.I., during the summer of 1989. It is addressed to the above concerns. Much of the material incorporates an affective approach. In order to validate the effects of the materials, the writer developed a survey instrument to ascertain the direction of student attitudes following an affective-based program of study. The results of this study will supply direction as to whether or not environmental attitudes can be influenced by activities that engage students in the affective domain.

DESCRIPTION OF THE POPULATION

Anamosa, a town of approximately 5,000, is the county seat of Jones county. The Anamosa Community School district has an enrollment of about 1,200. There are four buildings that serve Anamosa District students. The site of this study, West Middle School, houses 5th-8th grades. A number of students at West Middle School are enrolled in special programs. Learning disabled, and multi-categorical students are mainstreamed into many regular classes including this study population. The survey results of these special needs students were included in the study. However, the survey results of one of these students (#21) was removed from

the study group after reviewing the pretest and posttest scores for this individual.

This student's placement in special education is a result of frequent displays of inappropriate behavior. He was mainstreamed from a behavior disorder classroom. On the last day of class (survey posttest day) he became quite agitated. Before the posttest was administered, he was removed from his normal seating placement and moved to a neutral area. As a result, his scores did not necessarily reflect his true environmental attitude, and were therefore removed from analysis. The population of this study included Earth Science students enrolled in the 6th grade at West Middle School during school year 1990-1991 (N=99).

DESCRIPTION OF PROCEDURES

The sixth-grade Earth Science class at West Middle School in Anamosa, Iowa operates under a number of unique parameters. One such limitation is the time-frame that must be accomodated. This class meets for 50 minutes daily, (from 8:13 a.m. until 9:03 a.m.). The duration of this class is eight weeks. After an eight week session is completed by one section of students, that group of 25-30 continue on to another class in Social Sciences: Computer Keyboarding, Iowa History, or Social Studies. At this time a new section of sixth grade students begin their investigation of Earth Science. Once Earth Science is completed, students will not enroll in another science class until they become 7th graders. This creates a situation where the teacher has a choice to make. The instructor can focus learning objectives upon cognitive acquisition of major Earth Science themes including geology, hydrology, weather, and astronomy. However, the amount of cognitive content typically covered in a traditional Earth Science class, in reality, cannot be dealt with fairly in only eight weeks. It was decided by the writer of this research, that emphasis would be placed upon student attitude formation, wherein the direction of the class would be

determined by cognitive considerations, but activities would focus on the affective domain. Environmental attitude formation would be the main objective.

Another important consideration includes the K-12 curricula in the Anamosa Community School District. Students are offered Earth Science only during the sixth grade. Physical Science, Biology, Physics, and Chemistry are offered to upper level students at the middle and high schools. Science theme units, such as Elementary Science Study (ESS) comprise a major portion of the science curricula in the elementary grades. Examples of the units include 'Batteries and Bulbs', an investigation of electricity, and 'Balloons and Gases', an investigation of gases in the atmosphere. Many of the activities include valuable educational components including higher order thinking and cooperative learning, however the activities are mainly cognitive in nature.

Still another facet to be considered is the lack of science textbooks for science education in the Anamosa Community Schools. With the exception of high school science courses, all science materials are in the form of either commercially-prepared kits or teacher prepared units.

In order for the reader to better understand the mechanics of this Earth Science class, the following will describe a 'typical' day.

> Students arrive in the classroom at approximately 8:00 a.m. Among other activities, they view the tropical aquarium, water the plants and glance over articles displayed from the morning newspaper that apply to environmental or topics.
>
> At the 8:13 tone, students seat themselves and attendance is taken. A few moments are taken to discuss a current topic in the news. A discussion commences concerning the content of an article found in the morning newspaper concerning the surprisingly high number of deer killed on the state's highways. It seems this problem stems from the huge population of deer inhabiting Iowa's forests and farmlands. Students air their various points of view concerning deer management. One student believes all hunting should be banned as it violates the animal's right to life. Other students hold the attitude that nothing

can be done to solve the problem, as most natural predators have been eliminated from the state and overpopulation is inevitable. Still other students see a possible solution in an increase in bag and possession limits. Consequences of each of these approaches are also discussed. Students are not asked to alter their beliefs, they are only asked to realize that a diversity of beliefs is welcomed in this classroom.

Students are eagerly awaiting today's lesson. They will be building terraria out of recycled two-liter soda containers. They have brought rocks, shells, and miniature toy tractors to decorate their terraria. After introductory directions that emphasize individual freedom of decision-making in the construction of their terrarium, many questions are asked of the teacher.

"Which spider plant should I pick?" "Should I plant grass seeds also?" "How deep?" "How many milliliters of water should I add?"

These cognitive questions today are answered with another question.

"Why don't you experiment and see what happens?" "Do you want to try mulching yours?" "How much water do you think you'll need to succeed?" Would fertilizer help it to grow?"

Later, toward the end of the class period, the students are asked what the terraria and our earth have in common. Many spontaneous responses are given. Eventually, they realize the soil, plants and water represent Earth, and once sealed, no moisture will enter or escape, just like our own Earth's atmosphere. Students are reminded to note the events of the day in their journal and to write observations about the plant before class for the next few days. The tone for the next period sounds and class is dismissed.

No two days are the same since current events, and student interest levels vary. The essence of class has been shared above. The over-riding theme the writer wished to share is that the program is student driven and students thoughts, feelings and predictions are encouraged and honored. As a result of the affective

approach utilized in this Earth Science class, students are beginning to learn that they have a degree of power to manipulate the environment for good or bad, according to their wishes. They will learn also that honest decision-making mistakes are often unavoidable and acceptable. A synopisis of activities contained in the unit appear in Appendix A.

DESCRIPTION OF THE RESEARCH METHODOLOGY

The research survey instrument used in this study included thirty statements. Ten statements were designed to measure students' environmental attitudes. Eleven of the statements dealt with general concerns of students enrolled in a middle school program. Nine other statements described cognitive-based topics. The twenty statements and student responses to them not germane to the hypothesis were not included in the analysis of results. The survey was introduced as an "Attitude Survey of 6th Grade Students." The survey instrument (See Appendix B) incorporated a five point Likert-type scale that allowed the students to select from a range of choices from strongly disagree to strongly agree. A Thurstone scale was considered but the Likert scale was chosen after the writer discovered that the Likert scale was both simpler to construct and more reliable (Ary,

Jacobs, and Razsvieh, 1990). In addition, the Thurstone scale needs 50-100 items, a task that may have overwhelmed many of the 6th grade participants.

On the first day of each new eight-week Earth Science class, the 6th grade middle students were told:

"The Earth Science Department at West Middle School would like to survey 6th graders to see how they feel about certain general topics. Please answer by circling the number of your choice (1) indicates that you strongly disagree; (2) indicates you mildly disagree; (3) indicates you neither agree or disagree; (4) indicates you mildly agree; (5) indicates you strongly agree. Thank you for your sincere opinions."

Student's pretest and posttest attitude scores were then compared to see if their posttest responses reflected change in environmental attitudes.

ANALYSIS OF STATISTICAL DATA AND DISCUSSION

This is a descriptive study. The writer is seeking information about the nature of the relationship between an Environmental Education unit and its effects upon

students' environmental attitudes. Cause and effect are not shown. The data has been analyzed by separate t-tests for nonindependent samples. The standard table of t-values was used. The level of significance was set at the .05 level for directional (one-tailed) tests. The degrees of freedom (number of paired observations minus one) equaled 98. The t-ratio was set at 1.663 (appropriate for 98 degrees of freedom.) Any ratio higher than the t-ratio will suggest that environmental attitudes were significantly affected by the Environmental Unit.

Included in this study were ninety-nine 6th grade Earth Science students. Each of the participants was involved in an eight-week Environmental Education unit. Ninety-six of these students represented students from regular education classes. Three of the participants were mainstreamed special education students.

In analyzing the environmental attitude surveys, separate t-tests were calculated to measure the purported effects of the Environmental Education unit. Separate t-test values were calculated for the total student population and for gender. (See Appendix C)

Responses on the survey instruments were assigned numbers according to performance of environmental appropriateness as determined by the writer. When

students answered with the most environmentally appropriate response, they received a 5. The more distant the student's response was from the most environmentally appropriate answer, the smaller the numerical value assigned to the response. Thus the least appropriate answer was assigned a value of 1. Some items had reverse wording, still the responses of highest environmental appropriateness achieved a value of 5. Since ten items dealt with environmental attitudes, a score of 50 was the highest score possible. A score of 10 was the lowest (minimum score) a child could receive. Each student's pretest and posttest scores were then recorded so they could be compared.

After a student completed both the pretest and the posttest, the growth score was calculated. The growth score was calculated by subtracting the student's pretest score from the posttest score. A student with a relatively high pretest score had a diminished opportunity for a large growth on the posttest. Conversely, a student whose pretest score revealed a lack of environmental attitude had much more latitude for growth. In order to illustrate the manner in which a student's pretest score could affect the growth possible on the posttest, the following sample scenarios are provided:

> Student #79 scored a perfect 50 on the pretest and 50 on the posttest. This represents a mean growth of 0.0. Student #54 had the lowest pretest score (14) but had a posttest score of 27, or a positive growth score of 13. Student #01 scored higher on the pretest (40) than on the posttest (37). As a result this student showed a negative growth score of -3.

Means were calculated for the entire group, for gender, and also for each of the 10 environmentally-based questions.

The dependent t-test ratio that was established for significance in the total group was 1.663 at the .05 level. The t-test calculated for pretest/posttest growth of the entire group was 7.700. This indicates that the research hypothesis was accepted. There is a statistically significant difference between pretest and posttest scores of sixth-grade students who have participated in an eight-week unit devoted to Environmental Education. The overall mean environmental attitude growth recorded for the 99 students in this research study was 3.30 points. (See Appendix C)

The t-test for nonindependent samples ratio that was established for significance among the 32 females being studied was 1.695 at the .05 level. The t-test calculated for pretest/posttest growth of the females in the group was 3.360. There is a statistical significance between pretest and posttest scores of sixth-grade females who have participated in an eight-week Environmental Education unit. (See Appendix C)

The t-test for nonindependent samples ratio that was established for significance among the 67 males being studied was 1.669 at the .05 level of significance. The t-test calculated for pretest/posttest growth of the males in the group was 7.170. There is a statistically significant difference between pretest and posttest scores of sixth-grade males who have participated in an eight-week unit devoted to Environmental Education. (See Appendix C.) Thus, on all counts, the eight-week unit produced statistically significant results, supporting the original hypothesis.

CONCLUSIONS AND RECOMMENDATIONS

STATEMENT OF THE PROBLEM

The purpose of this research was to measure the effects of an eight-week Environmental Education unit on the attitudes of sixth grade Earth Science students.

METHOD OF THE STUDY

The population of this descriptive research study included 99 sixth-grade Earth Science students attending Anamosa's West Middle School. The students were given an 'Attitude Survey of Sixth-Grade Students.' (See Appendix B) This was administered at the beginning and at the conclusion of an Environmental Education unit. (See Appendix A) Mean improvement was computed for the entire group, and for each gender. T-tests for nonindependent samples were computed to determine if the observed posttest improvement reached the .05 level of significance appropriate for a directional test. T-tests were conducted for total group and each gender.

FINDINGS

T-tests of the original hypothesis revealed a significant difference at the .05 level of significance between pretest and posttest scores. As directional (one-tailed) t-tests indicate significance only in a positive direction, i.e. improvement, it may be assumed that the significance demonstrated in the findings is in a positive direction. The hypothesis that there is a statistically significant relationship between pretest and posttest environmental attitude scores of sixth-grade students who have participated in an eight-week Environmental Education unit is thereby supported.

Mean growth, as well as t-tests for nonindependent samples were calculated for each gender. In both males and females, environmental attitude growth of statistical significance was observed. However, contrary to Borden and Schettino (1979), female participants' scores showed a smaller growth than the males in the research group. In addition, although the male pretest mean score (35.03) was lower than the female pretest mean score ((35.63), males showed more total growth (improvement.) The male posttest mean (38.60) was higher than the female posttest mean of (38.34). (Refer to Table I.)

TABLE I

STUDENT ATTITUDE SURVEY RESULTS

Pretest/Posttest Comparison of Student Environmental Attitude Means

Gender	N=	Mean Pretest Score	Mean Posttest Score	Mean Score Improvement
Female	32	35.63	38.34	2.72
	67	35.03	38.60	3.57
	99	35.22	38.52	3.30

In order to analyze the levels of attitudinal growth demonstrated by gender, an interval table was constructed indicating both positive and negative growth trends. Scores were grouped in intervals of three in the positive and negative range. Also included was an interval for those individuals demonstrating neither positive nor negative growth. (Refer to Table II.)

TABLE II

ATTITUDE GROWTH INTERVAL TABLE

GROWTH SCORES	# OF MALES	# OF FEMALES
+13 - +15	4	1
+10 - +12	2	0
+ 7 - + 9	13	4
+ 4 - + 6	11	10
+ 1 - + 3	21	7
0	7	4
- 1 - - 3	9	4
- 4 - - 6	0	1
- 7 - - 9	0	1

After examining the above table, gender median and mode were calculated. The median for males was at the +4 - +6 interval. The median for the females was at the +1 - +3 interval. This was expected as males' mean was higher (3.57) than the females' (2.72.)

The modes calculated for gender differences indicated slightly different results than did the median. The mode for males was at the +1 - +3 interval. The mode

for females was at the +4 - +6 interval. A variance might be expected in the modes of the two genders, based upon population size discrepancies.

After examining the nature of the positive score clusterings, one notices that the ratio of positive score growth, male to female, approximately equals the ratio of the study population, male to female. The 2:1 ratio existing in Table II would indicate that if, indeed, the gender population sizes were more equal, one could expect a more equal representation in positive score growth as well.

Out of 99 students in the study, 72 students had a positive attitude growth score, 11 students had no score change over the eight-week period, and 16 students had a negative environmental attitude growth score.

Items posed to students on the survey instrument have been summarized to allow for analysis and interpretion. Total point growth scores were calculated from pretest to posttest item. (Refer to Table III)

TABLE III

ATTITUDE SURVEY ITEM ANALYSIS

ITEM #	PRETEST TOTAL SCORE	POSTTEST TOTAL SCORE	POINT DIFFERENCE SCORE
1	397	449	+52
4	359	391	+32
5	241	277	+36
7	392	423	+31
8	377	391	+14
10	299	371	+72
14	316	317	+ 1
17	336	359	+23
25	381	390	+ 9
29	389	438	+49

MEAN DIFFERENCE = 31.9

As a point of reference, it should be noted that the mean difference per item was 31.9. Four items had a point difference total well below the mean difference. These included items #8, #14, #17 and #25. These items dealt with erasing mistakes versus using a new piece of writing paper (#8), watching television programs with a

pollution theme (#14), spending time outdoors versus playing video games (#17), and whether children are overly worrysome about the environment (#25).

Regarding item #8, students with a strong desire for academic success may have felt that the trade-off between wasting a piece of paper was insignificant in the face of perhaps a lowered score for messy work. Also, because our class recycles, students may have thought the threat of environmental damage was reduced as the piece of paper in question would not end in our landfill.

Students perhaps felt environmentally-oriented television viewing was not a particularly interesting activity. Perhaps students had viewed so much of this kind of television programming that it had become boring by its predictability.

Students in two of the four sessions had Earth Science during the winter season. It is possible that sitting in front of a video game (#17) was viewed as a warmer, more comfortable activity than walking in the woods.

The wording of item #25 (children worry...) may have offended some of the students. Many pre-adolescents do not like to think of themselves as children, nor particularly worried about anything.

Items #1, #10 and #29 had a total difference well above the mean difference. These items dealt with environmental worries (#1) and individual solutions to pollution, #10 and #29, the latter incorporating reverse wording to assist in verification of findings for the previous item.

The first item on the survey instrument may have commanded more thoughtful and responsible consideration. This item was stated in very general terms, and as a result was subject to individual interpretations. Environmental concerns were a major focus of the course. Currently, it is popular to be concerned about the environment. Some may see environmental concern as a means of attaining respectability and acceptability.

Much of the content of the Earth Science course dealt with personal involvement in reducing pollution (#10) i.e. recycling and avoiding the perils of toxic wastes. This item was stated in very general terms and permitted a wide range of responsible attitudes. Environmentalism was a major objective of Earth Science.

The wording of item #29 (it is silly...) might have caused students to react in disagreement. Pre-adolescents do not want to appear silly. This question was worded in quite general terms. Students

could fit the content of the question into their own perspective.

Three items: inability to help solve environmental problems, (#4) population control, (#5) and a personal litter statement, (#7) all scored very close (within 5 points) of the mean difference.

The reverse wording of item #4 may have confused students. Students needed to strongly disagree to achieve an environmentally appropriate score. In theory, students should have scored approximately the same as they did on item #10, which was not worded negatively. Both items addressed students' ability to affect change in their environment.

Population, its effects, and its control is a volatile subject. As a result, it was given a cursory treatment. Perhaps a more in-depth treatment of the topic would have increased the attitude associated with item (#5).

Litter and its control (#7) was not addressed per se. Outdoor excursions were undertaken during each eight week session. On each of these field trips the writer of this research modeled litter pick-up. Students would then ask if they would help. Soon, most if not all of the debris that had previously been on lawns and sidewalks was being carried back to our classroom.

Inclusion of litter awareness in a revision of this Environmental Education unit might raise the scores of this item.

CONCLUSIONS

This descriptive research supports the hypothesis that exposing sixth grade students to an Environmental Education unit can make significant changes in their environmental attitude. On the posttest, the students improved their mean environmental attitude scores 3.30 points over their pretest scores. This is, in fact, a significant difference.

A total of 99 students participated in this research study. A pretest was administered to each of the students to measure their environmental attitude level prior to the unit of study. At the conclusion of the eight-week Environmental Education unit, a posttest was given to determine if the level of students' environmental attitude had changed.

Environmental education units are incorporated across-the-curriculum into each grade level, kindergarten through the 12th grade in the Anamosa Community School District. Would the mean improvement scores have been higher if the students had entered sixth-grade with less

environmental training in the earlier grades? This variable bears further investigation.

Students in the middle grades (5-8) are transitory in their learning styles. Many have come from elementary schools where hands-on activities and 'learning by discovery' formed the basis for their learning. Planting and observing seeds growing, and taking walks to draw trees and flowers are quite typical environmental activities in Anamosa's primary grades. To remove the discovery element for sixth-graders with textbooks, and lectures would most likely be met with failure. Alaimo and Doran (1980) provided a study that showed the futility of such an approach. Students that were provided only knowledge about the environment without a chance to interact with it acquired a pessimistic view of their environment. The lessons in this unit were designed to minimize the effects of a cognitive-only domain approach.

Before activities were included in this Environmental Education unit, they were analyzed to ascertain if they were developmentally appropriate. Piaget's model of developmental stages was used. Students in the sixth grade typically have exited the Preoperational Stage. Students in the Preoperational stage are egocentric and often demonstrate faulty

cause-and-effect reasoning. A healthy environmental attitude is based partly in causes and effects as well as being geocentric in nature. If progress to the next developmental stage, Concrete Operations, were delayed, the results of both the pretest and posttest would have been affected.

The students included in this study were enrolled in the sixth grade. Middle school students are prone to respond best to lesson design based in activity, rather than one based in lecture. Many of the activities performed in class were based in the affective domain. However, some activities did blend affective and cognitive elements. It is possible that the balance of affective to cognitive lessons, indeed, is a major factor in achieving a responsible environmental attitude. Perhaps a different blend of domains when designing environmental curricula would result in even a higher mean improvement. (See Appendix A)

This research included only one of Maloney's Measures of Environmental Attitude components (1983). These components include Affect, Verbal Commitment, Actual Commitment, and Knowledge attitude components. Only the Affect component was included as part of this study. A fuller understanding of each of these

components would allow for a greater comprehension of student environmental attitudes change.

Contrary to research on the subject of gender and environmental attitude, the data (see table I) showed a greater enviromental attitude change among the males. Hounshell and Liggett (1973) concluded that females demonstrated a more environmentally appropriate attitude than did males.

The writer of this research noted the pre-test battery had scores that were higher than expected. As shown in Table I, females scored higher on the pretest than did the males in the population. As a result of this, it was more difficult for females to obtain significant posttest growth scores. Other variables in the study beyond the control of the reseacher may have had an impact on this outcome.

One such variable to consider is that many of the students had not had a male science teacher before this class was conducted. This could have had an effect on the outcome.

Another factor that could have altered the findings was the gender distribution. Of the 99 students being studied, only 32 were females. This uneven distribution may have skewed the results.

Still another factor that may have had a consequence in the findings is the fact that of the 99 students who were participants in the study, fourteen were enrolled in a Talented and Gifted program. Of these, ten were male and four were female. In examining the Talented and Gifted students' scores, it was discovered that their total change (+3.1) was less than that of the entire population (+3.3). However, the female Talented and Gifted students showed a total change of +4.7. The mean score improvement in the general female population was 2.72. The male students in the Talented and Gifted program demonstrated a total change in environmental attitude of +1.6. However the mean score improvement in the general male population was 3.57. It is quite possible that the gender and individual learning styles of Talented and Gifted students have an effect in the gaining of appropriate environmental attitudes.

In addition, an interesting paradox exists with some students who already had an environmentally appropriate attitude. Gifford, Hay, and Boros (1983) found that lower than expected affective scores may surface in individuals who once felt very strongly about the environment, and as a consequence of 'doing their share' they may actually show a decline in their positive stance due to the continued abuses of the environment.

These ideas about environmental education students and their pretest/posttest results must be considered speculative. Further work would be necessary to confirm or reject them. However, greater understanding of individual differences in relation to environmental attitudes will create greater potential for designing and implementing quality environmental education programs.

RECOMMENDATIONS

This descriptive research study was designed to investigate potential changes in environmental attitudes of sixth grade students during an eight week Environmental Education unit. As a result of the literature review, and in light of the significant changes demonstrated by student pretest/posttest performances, several recommendations are offered by this researcher to assist colleagues involved in sixth grade Environmental Education curricula development. First, there is a need to engage children in activities during an Environmental Education unit. Pre-adolescents attain behavioral objectives when they are allowed to investigate a topic, either individually, or as a group, rather than through a lecture or textbook format. Second, a shared locus of control would seem to be a

beneficial aspect of an Environmental Education curricula. Earth Science topics are not vertically articulated as are math and language lessons. As a result, it is not essential that each class and each student receive exactly the same lessons. It is the approach, rather than the content that seem to warrant success. As reported in the review of literature, experts are not in agreement as to which approach is more effective in achieving student environmentally appropriate attitudes. However, lessons designed in the affective domain were discussed at some length in the review of literature and most, if not all, experts encouraged incorporation of affective-based lesson design. The fact that pre-adolescents are still forming their environmental attitudes makes the inclusion of affective-based lessons critical.

Upon examinimg the 'Earth Science Activity List' in Appendix A, the reader will discover that this Environmental Education unit does not address only the affective domain. There are many activities that include knowledge attainment as instructional objectives. The writer of this research agrees with the views of Ramsey and Rickson (1976). That is, lessons based in both cognitive and affective domains have a circularity, one causing an increase in the other.

To summarize then, an effective sixth grade Environmental Education unit designed to harbor an increase in appropriate environmental attitudes would (1) include many hands-on activities, (2) be flexible and tend to flow in the direction of student interests and (3) be based in the affective domain, however not exclusively. Cognition augments attitude formation and attitude augments knowledge formation.

Investigating the following topics might help us further understand the conditions associated with attitude change and the ways to measure such changes.

Additional studies should be aimed at influencing and assessing environmental attitudes at different age and grade levels. A longitudinal study should be conducted for one group of students. Environmental attitudes of a study population in kindergarten, third grade, sixth grade, ninth grade and twelfth grade would add to the existing body of knowledge concerning shifts in environmental attitudes.

Environmental attitudes of gifted, regular education, and special education students should be investigated. Such studies could help determine lesson content and activity format with the most appeal. An investigation into environmental attitude attainment of male and female Talented and Gifted students could be

conducted. Specifically, why did female Talented and Gifted students in this study have a mean score improvement three-fold the mean improvement score of male Talented and Gifted students?

Studies could be designed to isolate the factors which may account for the persistence of undesirable environmental attitudes. Specifically, why did three of the special education students mainstreamed into the Earth Science class become less favorably disposed to environmental issues?

Additional research should be conducted to determine if environmental attitude changes occur in an Environmental Education unit based totally in cognitively-based objectives. Would special education students acquire more appropriate environmental attitudes if the lessons were presented in the cognitive domain only?

Research should be conducted into whether gender differences require environmental education program approaches that utilize different combinations of objectives and activities. Do both genders learn environmental attitudes best when lessons are delivered in the affective domain or cognitive domain, or is a blend of the two the most productive? In this research male environmental attitudes were found to be less

environmentally appropriate than females at the time of the pretest. However when their attitudes were measured on the posttest, it was found that males had a more environmentally appropriate attitude than the females. These findings conflict with another similar study conducted by Hounshell and Liggett (1973.) More research should help clear up the nature and origin of these discrepancies.

Survey instrument design should be investigated. Is the Likert scale the most appropriate for research of this type? The survey instrument of a similar study might include all four of Maloney's Attitude Components. This component scale includes verbal committment, actual comittment, knowledge, and the affective domain. In addition the survey instrument should be written with an equal number of items in each of the components.

Further studies should include topics such as population effects, ozone depletion, the rain forest destruction, and litter. The addition of these issues might provide a better global measure of individual environmental attitudes.

Further studies should be made in districts similar and dissimilar to Anamosa. This would help us better understand the effects of locale upon the environmental awareness and concerns of students.

The population included in this study warrants further study. Variations in environmental attitudes could be plotted over a period of several years.

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APPENDIX A

EARTH SCIENCE CLASS OBJECTIVES, LESSON DESIGN AND ACTIVITY LIST

EARTH SCIENCE CLASS OBJECTIVES

This Earth Science course has several major instructional objectives. These include:

1. The student will develop an awareness, an appreciation, and a concern for his/her own environment.

2. The student will learn about the various components that comprise the natural and man-made environment.

3. The student will gain skills necessary for developing critical thinking and make value judgements about man's impact on the environment and the societal and environmental changes from natural resource use.

4. The student will gain appreciation of the public policy decision-making process and gain beliefs concerning their ability to affect positive change.

5. The student will gain knowledge about the basic environmental concepts that affect life, including the conservation of natural resources.

This Earth Science course has behavioral objectives designed to give structure and purpose to each lesson while allowing for varying degrees of student ability and interest levels. The behavioral objectives are written in the Hunter lesson design model.

A SAMPLE LESSON DESIGN

UNIT	GROUNDWATER
LESSON TITLE	DECIDING ABOUT LAWS
ANTICIPATORY SET	DEMONSTRATE OUR ENVIRONMENTAL ISSUES COLLECTION
TIME NEEDED	45 MINUTES
OBJECTIVE	STUDENTS WILL APPRECIATE THE DIFFICULTY OF WRITING LAWS THAT ARE FAIR TO ALL, YET SUPPORT A QUALITY ENVIRONMENT STUDENTS WILL EXPRESS THEIR BELIEFS CONCERNING NEEDED LEGISLATION WITH THEIR PEERS, AND/OR THEIR LEGISLATORS
MODEL	CREATE A CLASS LIST OF THE PRACTICES THAT ARE CAUSING PROBLEMS SHOW EXAMPLES OF UNCLEAR AND UNFAIR LAWS AS WELL AS EXAMPLES OF CLEARLY WRITTEN AND LAWS THAT ARE FAIR TO ALL
CHECK FOR UNDERSTANDING	WRITE ON THE BOARD GOOD AND WEAK EXAMPLES OF LAWS AND HAVE THE STUDENTS EXPLAIN WHY OR WHY NOT THEY ARE WORTHY LAWS
MATERIALS NEEDED	OUTLOOK ACTIVITY-HERE COMES THE JUDGE, EXAMPLES OF ENVIRONMENTALLY BASED LAWS
ASSIGNMENT	EACH PAIR OF STUDENTS WILL WRITE AT LEAST FIVE LAWS SUPPORTING THE ENVIRONMENT
NEW STATE STANDARDS	HIGHER ORDER THINKING SKILLS GLOBAL STUDIES

A SAMPLE LESSON DESIGN

UNIT	CONNECTIONS
LESSON TITLE	BUGAWAY INCORPORATED
ANTICIPATORY SET	HOLD UP A CAN OF RAID BUG KILLER AND ASK WHAT PURPOSE IT SERVES
TIME NEEDED	TWO-50 MINUTE CLASS SESSIONS
OBJECTIVE	THE STUDENT WILL BELIEVE THAT THE BENEFITS OF INSECTS OUTWEIGH THE DISADVANTAGES
STUDENT NEEDS TO KNOW	WHAT SIDE OF THE ISSUE THEY SUPPORT, WHAT COUNTY SUPERVISORS DO, AND WHAT A DEBATE ENTAILS
MODEL	EXPLAIN TO THE TWO GROUPS THEIR ROLES IN TOMORROW'S DEBATE INCLUDING:INFORMATION GATHERING, STRATEGY IMPLEMENTATION, AND THE VALUE OF COOPERATION WITHIN THEIR DEBATE GROUP
CHECK FOR UNDERSTANDING	WHILE WORKING WITH THE TWO FACTIONS, THEY SHOULD BE ABLE TO DEFEND THEIR BELIEF CONCERNING THE RELATIVE VALUE OR DESTRUCTIVENESS OF INSECTS
MATERIALS NEEDED	WE HATE BUGS-LETTERS WE LOVE BUGS-LETTERS ENTOMOLOGY BOOKS ENCYCLOPEDIAS MATERIALS FOR SIGNS BALLOTS FOR SUPERVISORS' VOTE
ASSIGNMENT	BE PREPARED TO PRESENT YOUR FACTS AND FEELINGS TOMORROW DURING THE 'SUPERVISORS MEETING

NEW STATE STANDARDS---------HIGHER LEVEL THINKING SKILLS
GLOBAL SKILLS
COMMUNICATION SKILLS
CAREER EDUCATION
COOPERATIVE SKILLS

A SAMPLE LESSON DESIGN

UNIT----------CONNECTIONS

LESSON TITLE----------TEARS OF COMPASSION

ANTICIPATORY SET----------BEGIN A TAPE OF 'NORTH AMERICAN FLUTE MUSIC' AND DIM THE LIGHTS

TIME NEEDED----------50 MINUTES

OBJECTIVE----------STUDENTS WILL BE ABLE TO APPRECIATE CHIEF SEATTLE'S APPEAL THAT ATTEMPTED TO PREVENT AMERICAN EXPANSIONISTS FROM PURCHASING THEIR HOLY GROUND

STUDENTS WILL VOLUNTEER TO PRESENT DIFFERENT MEDIA TO EXPLAIN THEIR FEELINGS OF THE INDIAN/AMERICAN CONTROVERSY

STUDENT NEEDS TO KNOW-------BACKGROUND OF THE CONFLICT BETWEEN THE NATIVE AMERICANS AND THE WESTWARD EXPANSION

MODEL----------PLACE ONE PREVIOUSLY COMPLETED MURAL DEPICTING THE BELIEF THAT ONE CANNOT OWN THE SKY, OR OWN THE LAND ON THE BOARD

CHECK FOR UNDERSTANDING-----WHEN GOING FROM GROUP TO GROUP, HAVE VOLUNTEERS EXPLAIN THEIR FEELING ON THE LAND ETHIC AND HOW OUR LAND USE POLICIES VIOLATE/DO NOT VIOLATE THE ENVIRONMENT

MATERIALS NEEDED----------TAPE PLAYER
FLUTE MUSIC TAPE
VARIOUS CRAFT SUPPLIES
COPY OF SEATTLE'S SPEECH

ASSIGNMENT----------TOMORROW, BE READY TO PRESENT
A MEDIA DEPICTION SHOWING
YOUR INTERPRETATION OF THE
READING JUST COMPLETED

NEW STATE STANDARDS---------HIGHER ORDER THINKING SKILLS
GLOBAL SKILLS
COMMUNICATION SKILLS
MULTI-CULTURAL/NON-SEXIST

EARTH SCIENCE ACTIVITY LIST

1. Instruct students to draw a 'typical' scientist. Discuss what science is and isn't. Instruct students that we will be learning many things about our earth, its environment and astronomy in this course called Earth Science. (Cognitive and Affective)

2. Groundwater. Instruct the students to make a small journal from construction paper and notebook paper. This will be used to gather reflections and observations from class. Give some highlights of the last 4.6 billion years on Earth. (Cognitive)

3. Groundwater. Act out the hydrologic cycle. Build terraria in class using two-liter pop bottles. Students will use journals to note changes. The terraria and our Earth will be compared during ensuing discussions. (Cognitive and Affective)

4. Groundwater. Offer Groundwater word-search and cross-word puzzles. Work in pairs. (Cognitive)

5. Groundwater. Breifly describe geology of Jones county. Show a model of an aquifer. Explain Big Springs in N.E. Iowa. Have a "Percolation Race" with five substrates. Discuss race results. (Cognitive and Affective)

6. Groundwater. Talk about farm contaminants. Discuss feelings about increased food production v.s. a purer environment. (Cognitive and Affective)

7. Groundwater. Discuss a particular pollutant-nitrate. Explain the threat it poses. Ask selected students to bring in ground and surface water samples. (Cognitive)

8. Groundwater. Test for nitrates in water samples. Use Hach test kits. (Cognitive)

9. Groundwater. Working in pairs, create a mural or poster showing your feelings about the Earth, its resources, and how they are used. Try to incorporate themes from several class experiences. (Affective)

10. Groundwater. Invite or visit a resource person to enhance the unit. (Cognitive and Affective)

11. Groundwater. Give the evaluation. Have students write an essay concerning their feelings about topics related to the Groundwater unit. (Affective)

12. Connections. Play "Oh, Dear," then disuss carrying capacity of the land. (Cognitive and Affective)

13. Connections. Students plant exactly 25 grass seeds and attempt to get 100% germination. Discuss variables and the asthetic properties of plants in general. (Cognitive and Affective)

14. Connections. Frogs, Bugs, and People. Students role play a situation where a company promises to rid all insects in Jones County. Half the class is for the concept and half against. Students caucus and attempt to sway their supervisors with facts and feelings that support their role. Next day, a mock meeting is held with a vote taken. (Cognitive and Affective)

15. Connections. Frogs, Bugs and People. Students are read an article about frog's legs being a popular food item in Europe and the U.S. They are being exported from Bangledesh. Bangledesh then has to use more pesticides. Students write a short promotion letter to support their feeling about the topic. Students also compose a radio ad or jingle to protest the frog leg exporters. (Cognitive and Affective)

16. Connections. Scavenger Hunt. Students round up 20 items from a list supplied and in doing the activity, find they have learned about the environment and themselves. (Affective)

17. Connections. Not For Sale. Students listen to 'Clair de Lune' and then sounds of traffic and general urban noise are introduced. The subject of noise pollution and its effects are bounced around in discussion format. (Cognitive and Affective)

18. Connections. Seed Behavior. This is a wrap-up of Seed Behavior begun 25 days ago. Students attempt to account for the lack of 100% germination in their experiments. (Cognitive)

19. Connections. Three Magic Beans. Students, working in groups of two are given three bean seeds. Each has had a special treatment. Some bean seeds have been soaked, others have been baked, and still others have been frozen. Predictions are made about the possible outcomes and then they are planted and observed for 10 days. (Cognitive)

20. Connections. Wild Card Walk. Each student is handed a task card. (Example:find three examples of energy efficiency, and three examples of wasteful energy practices.) Students are then taken on a walk around the general area of the school. Students discover answers to their task cards, as well as seeking out their friends' cards and helping them out. (Cognitive and Affective)

21. Astronomy. Introductory Lesson. Students construct a folder to hold materials used in the unit. Students are given a star calendar for that month and are given time to complete a word search. (Cognitive)

22. Astronomy. Introduce Constellations. Students review the five circumpolar constellations through slides and drawing them. (Cognitive)

23. Astronomy. Constellation Generator. Give students a blank piece of paper. Have them make 30-50 dots on the paper. Then have them look for a familiar shape in their 'stars'. Students then generate a myth concerning their constellation. (Cognitive and Affective)

24. Astronomy. Star Lab. Students are taken into the planetarium called 'Star Lab.' Here review can be completed and many questions about stars can be addressed. (Cognitive and Affective)

25. Astronomy. Planet Creations. Students research a favorite planet in a group of three. After basic facts are collected, assign students to create a life-form that could survive on the planet of their choice. Students must be able to defend why their organism would desire the planet's conditions. (Cognitive and Affective)

26. Astronomy. Planet Trivia Game. Divide class into two teams. Ask questions relating to planets. Teams are allowed to confer before answering. (Cognitive)

27. Astronomy. Time Capsule Activity. This activity deals with individual student values. Students first respond alone, then in small groups. Charting is involved. (Affective)

28. Astronomy. Toys In Space. Show several children's toys. (Example: a yo-yo, marbles, and a gyroscope.) ask students what makes them work. Ask if they would operate in a zero-gravity situation. Then show the video of Toys In Space. (Cognitive and Affective)

29. Astronomy. Evaluation Day. Keep it simple. Include at least one essay question allowing for student feedback about experiences they have had watching the sky. (Cognitive and Affective)

30. Connections. Tears of Compassion. Students interpret an excerpt from Chief Seattle's speech using different media. Concerns about the future of the planet are discussed. (Affective)

APPENDIX B

(Items marked with an asteric are designed to measure attitudes toward environmental issues and practices.)

ATTITUDE SURVEY OF 6TH GRADE STUDENTS

The Earth Science Department at West Middle School would like to survey 6th graders to see how they feel about certain general topics. please answer by circling the number of your choice. (1) indicates that you strongly disagree; (2) indicates you mildly disagree; (3) indicates you neither agree nor disagree; (4) indicates you mildly agree; (5) indicates you strongly agree. Thank you for your sincere opinions.

		Strongly Disagree				Strongly Agree
* 1.	I worry about the environment (problems like pollution.)	1	2	3	4	5
2.	With over-population a growing problem, people getting married should plan no more than two children.	1	2	3	4	5
3.	It is fun to participate in extra school activities like band, student council, and camp.	1	2	3	4	5
* 4.	I cannot help solve environmental problems in the area where I live.	1	2	3	4	5
* 5.	The cause of many problems in the world today is too many people.	1	2	3	4	5
6.	There should not be a curfew in Anamosa for young people under the age of 16.	1	2	3	4	5
* 7.	I don't litter. I expect others to do the same.	1	2	3	4	5
* 8.	If I make a mistake on a piece of paper, I usually get out a brand-new piece instead of erasing the mistake.	1	2	3	4	5
9.	I am satisfied with my success in school.	1	2	3	4	5

		Strongly Disagree				Strongly Agree
* 10.	I think there are many pollution problems I can stop.	1	2	3	4	5
11.	I would rather go to a rock concert than a football game.	1	2	3	4	5
12.	One way of controlling a drought is to irrigate crops.	1	2	3	4	5
13.	I enjoy reading a good book.	1	2	3	4	5
* 14.	I don't care to watch TV programs about pollution.	1	2	3	4	5
15.	I would be willing to be in the space program as a 'student in space.'	1	2	3	4	5
16.	My family gets rid of our newspapers by simply throwing them away.	1	2	3	4	5
* 17.	I enjoy being in the woods more than I enjoy playing video games.	1	2	3	4	5
18.	When I have children they will be able to watch all the TV they wish to.	1	2	3	4	5
19.	When I pick a career, my main consideration will be how much money I can make.	1	2	3	4	5
20.	I really don't miss recess.	1	2	3	4	5
21.	The recent fish kills in the Wapsipinicon river are a direct result of chemical run-off.	1	2	3	4	5
22.	The water we drink here is as pure as it was 100 years ago.	1	2	3	4	5

		Strongly Disagree				Strongly Agree
23.	Some of the nicest people I know are teachers.	1	2	3	4	5
24.	The topsoil in Iowa is as deep as it was 100 years ago.	1	2	3	4	5
* 25.	Children worry too much about problems of the environment.	1	2	3	4	5
26.	Doing well in school is important to me.	1	2	3	4	5
27.	Using a lot of weed-killer is an good way to have an excellent garden.	1	2	3	4	5
28.	I am usually in bed by 9:00 on a school night.	1	2	3	4	5
* 29.	It is silly to think that I can make our environment healthier.	1	2	3	4	5
30.	The chemicals that get put on the soil don't get into the water that we drink.	1	2	3	4	5

Thank you for sharing your opinions with us.

APPENDIX C

(* indicates student removed from study)
(See page 15)

STUDENT DATA SUMMARY TABLE ENVIRONMENTAL ATTITUDE SCORES

STUDENT #	SEX	PRETEST SCORE (50)	POSTTEST SCORE (50)	D	D2
001	F	40	37	-3	+9
002	F	33	33	0	0
003	M	44	42	-2	+4
004	M	35	36	+1	+1
005	M	38	39	+1	+1
006	F	42	35	-7	+49
007	F	36	40	+4	+16
008	F	34	38	+4	+16
009	F	35	36	+1	+1
010	M	36	38	+2	+4
011	M	32	37	+5	+25
012	F	43	46	+3	+9
013	M	37	40	+3	+9
014	M	29	29	0	0
015	M	38	38	0	0
016	M	33	34	+1	+1
017	M	42	43	+1	+1
018	M	32	34	+2	+4
019	F	40	42	+2	+4
020	M	36	30	-6	+36
* 021					
022	M	29	28	-1	+1
023	M	35	39	+4	+16
024	M	42	44	+2	+4
025	F	38	40	+2	+4
026	F	41	42	+1	+1
027	F	41	39	-2	+4
028	M	34	31	-3	+9
029	M	34	39	+5	+25
030	M	29	36	+7	+49
031	F	39	47	+8	+64
032	M	42	43	+1	+1
033	M	40	42	+2	+4
034	M	39	43	+4	+16
035	M	36	45	+9	+81
036	M	34	35	+1	+1
037	M	35	38	+3	+9
038	M	38	48	+10	+100
039	M	34	35	+1	+1
040	M	28	42	+14	+196
041	M	34	33	-1	+1
042	F	33	38	+5	+25
043	M	37	40	+3	+9

STUDENT DATA SUMMARY TABLE OF ENVIRONMENTAL ATTITUDE SCORES

STUDENT #	SEX	PRETEST SCORE (50)	POSTTEST SCORE (50)	D	D2
044	M	35	43	+8	+64
045	F	37	36	-1	+1
046	F	33	39	+6	+36
047	M	43	44	+1	+1
048	M	33	39	+6	+36
049	M	37	34	-3	+9
050	F	38	35	-3	+9
051	F	38	42	+4	+16
052	M	47	44	-3	+9
053	M	44	44	0	0
054	M	14	27	+13	+169
055	F	33	27	-6	+36
056	F	39	39	0	0
057	F	29	30	+1	+1
058	M	36	34	-2	+4
059	M	44	44	0	0
060	M	47	47	0	0
061	F	37	43	+7	+49
062	M	39	36	-3	+9
063	F	28	28	0	0
064	M	26	27	+1	+1
065	M	45	47	+2	+4
066	M	33	38	+5	+25
067	M	41	39	-2	+4
068	M	39	40	+1	+1
069	M	34	34	0	0
070	F	26	35	+9	+81
071	F	26	34	+8	+64
072	M	28	36	+8	+64
073	M	41	47	+6	+36
074	M	26	39	+13	+169
075	M	26	35	+9	+81
076	M	32	38	+6	+36
077	M	30	33	+3	+9
078	F	35	41	+6	+36
079	F	50	50	0	0
080	M	43	46	+3	+9
081	F	30	45	+15	+225
082	M	23	36	+13	+169
083	M	28	36	+8	+64
084	M	28	36	+8	+64

STUDENT DATA SUMMARY TABLE OF ENVIRONMENTAL ATTITUDE SCORES

STUDENT #	SEX	PRETEST SCORE (50)	POSTTEST SCORE (50)	D	D2
085	M	28	35	+7	+49
086	F	27	34	+7	+49
087	F	29	35	+6	+36
088	F	40	41	+1	+1
089	M	41	41	0	0
090	F	35	41	+6	+36
091	M	31	39	+8	+64
092	F	35	39	+4	+16
093	M	39	45	+6	+36
094	M	28	36	+8	+64
095	M	29	37	+8	+64
096	M	35	37	+2	+4
097	M	35	42	+7	+49
098	M	34	41	+7	+49
099	M	34	44	+10	+100
100	M	39	45	+6	+36
N=99				+336	+3022

DATA SUMMARY TABLE OF FEMALE ENVIRONMENTAL ATTITUDE SCORES

SCORE STUDENT #	SCORE SEX	PRETEST (50)	POSTTEST (50)	D	D2
001	F	40	37	-3	+9
002	F	33	33	0	0
006	F	42	35	-7	+49
007	F	36	40	+4	+16
008	F	34	38	+4	+16
009	F	35	36	+1	+1
012	F	43	46	+3	+9
019	F	40	42	+2	+4
025	F	38	40	+2	+4
026	F	41	42	+1	+1
027	F	41	39	-2	+4
031	F	39	47	+8	+64
042	F	33	38	+5	+25
045	F	37	36	-1	+1
046	F	33	39	+6	+36
050	F	38	35	-3	+9
051	F	38	42	+4	+16
055	F	33	27	-6	+36
056	F	39	39	0	0
057	F	29	30	+1	+1
061	F	37	43	+7	+49
063	F	28	28	0	0
070	F	26	35	+9	+81
071	F	26	34	+8	+64
078	F	35	41	+6	+36
079	F	50	50	0	0
081	F	30	45	+15	+225
086	F	27	34	+7	+49
087	F	29	35	+6	+36
088	F	40	41	+1	+1
090	F	35	41	+6	+36
092	F	35	39	+4	+16
N=32				+87	+881

DATA SUMMARY TABLE OF MALE ENVIRONMENTAL ATTITUDE SCORES

STUDENT #	SEX	PRETEST SCORE (50)	POSTTEST SCORE (50)	D	D2
003	M	44	42	-2	+4
004	M	35	36	+1	+1
005	M	38	39	+1	+1
011	M	32	37	+5	+25
013	M	37	40	+3	+9
014	M	29	29	0	0
015	M	38	38	0	0
016	M	33	34	+1	+1
017	M	42	43	+1	+1
018	M	32	34	+2	+4
020	M	36	30	-6	+36
022	M	29	28	-1	+1
023	M	35	39	+4	+16
024	M	42	44	+2	+4
028	M	34	31	-3	+9
029	M	34	39	+5	+25
030	M	29	36	+7	+49
032	M	42	43	+1	+1
033	M	40	42	+2	+4
034	M	39	43	+4	+16
035	M	36	45	+9	+81
036	M	34	35	+1	+1
037	M	35	38	+3	+9
038	M	38	48	+10	+100
039	M	34	35	+1	+1
040	M	28	42	+14	+196
041	M	34	33	-1	+1
043	M	37	40	+3	+9
044	M	35	43	+8	+64
047	M	43	44	+1	+1
048	M	33	39	+6	+36
049	M	37	34	-3	+9
052	M	47	44	-3	+9
053	M	44	44	0	0
054	M	14	27	+13	+169
058	M	36	34	-2	+4
059	M	44	44	0	0
060	M	47	47	0	0
062	M	39	36	-3	+9
064	M	26	27	+1	+1
065	M	45	47	+2	+4

DATA SUMMARY TABLE OF MALE ENVIRONMENTAL ATTITUDE SCORES

STUDENT #	SEX	PRETEST SCORE (50)	POSTTEST SCORE (50)	D	D2
066	M	33	38	+5	+25
067	M	41	39	-2	+4
068	M	39	40	+1	+1
069	M	34	34	0	0
072	M	28	36	+8	+64
073	M	41	47	+6	+36
074	M	26	39	+13	+169
075	M	26	35	+9	+81
076	M	32	38	+6	+36
077	M	30	33	+3	+9
080	M	43	46	+3	+9
082	M	23	36	+13	+169
083	M	28	36	+8	+64
084	M	28	36	+8	+64
085	M	28	35	+7	+49
089	M	41	41	0	0
091	M	31	39	+8	+64
093	M	39	45	+6	+36
094	M	28	36	+8	+64
095	M	29	37	+8	+64
096	M	35	37	+2	+4
097	M	35	42	+7	+49
098	M	34	41	+7	+49
099	M	34	44	+10	+100
100	M	39	45	+6	+36
N=67				+249	+2141