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Evaluation of Elkhorn Slough Reserve school programs : do they make a difference?

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**EVALUATION OF ELKHORN SLOUGH RESERVE SCHOOL PROGRAMS:
DO THEY MAKE A DIFFERENCE?**

A Thesis

Presented to

The Faculty of the Department of Environmental Studies

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

By

Kimberly Ann Shirley

December 2000

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ABSTRACT

EVALUATION OF ELKHORN SLOUGH RESERVE SCHOOL PROGRAMS: DO THEY MAKE A DIFFERENCE?

by Kimberly Ann Shirley

This study evaluated the education program at Elkhorn Slough National Estuarine Research Reserve near Moss Landing, CA. A pretest and posttest survey was developed for fourth graders to evaluate changes in knowledge and attitude after visiting Elkhorn Slough Reserve for a fieldtrip. Coupons for free family entry were given to all students. Return rate was monitored and parents were to complete surveys regarding transfer of knowledge upon coupon redemption.

Eight control and eleven treatment classrooms from eight schools participated. There was no significant difference in attitudes found. There was a significant difference in knowledge. Further analysis showed the increase was not across several topics, but was limited to one question. With or without this question, girls showed a significant growth in knowledge, although the boys did not.

No coupons were redeemed. Consequently, no parent surveys were filled out and knowledge transfer between child and parent could not be evaluated.

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TABLE OF CONTENTS

I. INTRODUCTION	1
Background	1
Importance.....	3
II. RELATED RESEARCH	7
Theoretical Framework	7
Knowledge and Attitudes	10
Survey Instruments.....	11
Experimental Methods	13
Child to Parent Transfer of Knowledge	18
III. OBJECTIVES	22
IV. METHODS	23
Introduction	23
Study System.....	23
Population and Sample.....	24
Experimental Design	27
Instrumentation and Data Collection.....	29
Analysis	31
V. RESULTS.....	34
Student Information.....	34
Attitude.....	34
Knowledge.....	36
Gender	38
Language	41
Distance from Elkhorn Slough.....	41
Visits to Outdoor Places	42
Teacher Questionnaire.....	42
Student Return Visits	43
VI. DISCUSSION	45
Attitude.....	45
Knowledge.....	48
Knowledge Questions-Specific Information	50
Gender	52
Language	54
Distance from Elkhorn Slough Reserve	54
Visits to Outdoor Places	55
Teacher Questionnaire.....	56

Student Return Visits	58
VII. CONCLUSIONS AND RECOMMENDATIONS	59
Attitude.....	61
Knowledge.....	62
Student Visits	63
Limitations	64
Future Research.....	65
REFERENCES	66
APPENDIX A: Tables and Figures.....	71
APPENDIX B: Letter to Treatment Teachers and Teacher Questionnaire.....	88
APPENDIX C: Letter to Control Teachers and Teacher Questionnaire	92
APPENDIX D: Letter to Parents: English, Spanish, and Human Subjects Letter	96
APPENDIX E: Student Coupon.....	100
APPENDIX F: Parent Surveys: Control and Treatment	102
APPENDIX G: Student Survey: Pilot and Final	106
APPENDIX H: Student Survey Questions and Answers.....	120

LIST OF TABLES

1. Student Summary for Treatment and Control Groups During the Pretest and Posttest Surveys. Numbers are given as frequency/percentage.....	72
2. Attitude Scores for Treatment and Control Groups (a) Descriptive Statistics, (b) ANCOVA ($p = .601$).....	73
3. Knowledge Scores for Treatment and Control Groups (a) Descriptive Statistics, (b) ANCOVA ($p = .044$).....	74
4. Knowledge Scores Without Question #18 for Treatment and Control Groups (a) Descriptive Statistics, (b) ANCOVA ($p = .115$).	75
5. Knowledge Scores for Girls in the Treatment and Control groups (a) Descriptive Statistics, (b) ANCOVA ($p = .009$).....	76
6. Knowledge Scores Without Question #18 for Girls in the Treatment and Control groups (a) Descriptive Statistics, (b) ANCOVA ($p = .040$).....	77
7. Knowledge Scores Without Question #18 for Boys in the Treatment and Control groups (a) Descriptive Statistics, (b) ANCOVA ($p = .807$).....	78
8. School's Distance from Elkhorn Slough Reserve.....	79

LIST OF FIGURES

1. Attitude Pretest and Posttest Means Between Treatment and Control Groups.....	80
2. Boxplot for Treatment & Control Attitude Scores - Pre & Posttest Surveys.....	81
3. Knowledge Pretest/Posttest Means for Treatment and Control Groups.....	82
4. Boxplot for Treatment & Control Knowledge Scores - Pre & Posttest Surveys...	83
5. Attitude Averages for CONTROL Groups by Gender.....	84
6. Attitude Averages for TREATMENT Groups by Gender.	84
7. Boxplot of Attitude Scores for BOYS.....	85
8. Boxplot of Attitude Scores for GIRLS.....	85
9. Knowledge Averages for Control Groups by Gender.	86
10. Knowledge Averages for Treatment Groups by Gender.....	86
11. Boxplot in Knowledge Scores for BOYS.	87
12. Boxplot in Knowledge Scores for GIRLS.....	87

I. INTRODUCTION

Background

As society works to solve our continuing environmental problems, education has increasingly become one of the primary tools used as a preventative measure. By educating children on the values of natural habitats and peoples' influences on these places, educators hope to instill a sense of stewardship, which will promote positive environmental behavior. As our awareness grows, environmental education is increasingly becoming infused into the curricula of our elementary, middle school, and high school students. Field trips are an important part of these curricula and can be used to facilitate comprehension with hands-on experiences and visual learning. Parks, zoos, aquariums, museums, and natural habitats are popular places for field trips. Just as other types of curricula are field tested and evaluated, it is important that environmental school programs at these sites be evaluated as well. Once evaluated, the institution can have greater confidence that effective environmental education is being provided, and schools can be assured that their money is being well spent.

There are several different types of evaluation for environmental education, but quantitative evaluation dominates the literature. This form of evaluation creates a framework which allows the researcher to review the program on an objective level and answer specific questions in a statistical manner. Since the researcher is not directly involved with the students, gathering data on various aspects of the program is typically done with surveys (Marcinkowski 1993). Using this framework, researchers often will

ask questions regarding changes in knowledge and attitude. These two variables have long been regarded as key elements in pro-environmental behaviors. Even though it has been argued that environmental knowledge and attitudes do not directly translate into good environmental behavior (Burrus-Bammel 1978; Newhouse 1990), it has been shown that attitude and knowledge are two of many variables which lead students to environmental behavioral changes (Hines, Hungerford, and Tomera 1987; Hungerford and Volk 1990).

In a review of 34 environmental education studies which evaluated changes in knowledge, attitudes, or behaviors, Leeming, Dwyer, Porter, and Cobern (1993) found that 14 of these studies showed positive results after the students participated in an environmental program (in-class methodology or out-door methodology). Six studies showed mixed results, while another 14 studies showed either negative results or were studies whose experimental designs were too weak to determine an outcome. These results demonstrate that attitude and knowledge may improve after an environmental program and that it is critical that the experiment be performed in a scientifically accurate manner. Leeming, Dwyer, Porter, and Cobern (1993) also noted that there were few studies which concentrated on students below the fifth grade and there were even fewer studies which focused on long term effects. Another evaluation study, by Fortner and Lahm (1990), provides a model study for this thesis research since the research was done at Old Woman Creek, Ohio which is another National Estuarine Research Reserve site. The questions asked are pertinent and the experimental technique is similar to what was used in this project. With a pretest and posttest design containing a control group of

students not attending the program and a treatment group that did, Fortner and Lahm found that fourth and fifth graders showed a significant increase in estuarine knowledge and change in attitude after their estuary experience. It is important to note that these tests were evaluated with an unusually high p value of 0.25. In addition, a majority of the growth in attitude and knowledge occurred between an in-class presentation by the estuary personnel and the actual field trip.

Importance

This project helped to fill several gaps which currently exist in the literature. First, there is very little published research regarding school program evaluations at National Estuarine Research Reserve (NERR) sites. Given that all 25 NERR sites have similar educational objectives, this research provided an experimental design and instrument that can be used by other NERR sites. Second, there is a need for research with younger children. Leeming, et al. (1997, 33) suggested that looking at younger students (grade K-8) is of greater interest than looking at older students as “(a) they are less likely to have well-established environmentally harmful behaviors to ‘unlearn,’ (b) they have a longer period to influence environmental quality, and (c) they may serve as effective agents to promote environmentally responsible behavior in others.” Third, follow-up data are not often considered in the published literature. This study attempted to look at the rate at which students visited the Slough (control group) or re-visited the Slough after their field trip experience (treatment group). A parent survey was prepared to help identify the reason for the visit, indicating follow up visiting behavior. Lastly, there is very little

research regarding child-to-parent transfer of knowledge. Two studies were available which showed that there is evidence for transfer of some environmental knowledge between child and parent (Sutherland and Ham 1992; Leeming et al. 1997). The parent survey was to provide information as to whether the parent learned anything about the Slough from hearing about the child's Elkhorn Slough Reserve school program experience.

The results of this project are important in the area of program evaluation. The available survey is a validated and reliable instrument for other researchers in areas of environmental education. Since it has a number of general environmental concept questions, it can be used for other outdoor education sites, aquariums, museums, and even programs used in the classroom. In addition, educators at Elkhorn Slough Reserve can use the survey later, after changes have been made to their program, so that comparisons and further evaluation can be accomplished.

The history of human influences and links to the Monterey Bay National Marine Sanctuary provided powerful reasons for Elkhorn Slough Reserve to teach local history and biology to school children. Currently, the potential influence for Elkhorn Slough Reserve school programs is far reaching, since these programs serve up to 10,000 students annually, from pre-school to college level (Martinez 1998). Elkhorn Slough Reserve is the largest wetland area in the Monterey Bay National Marine Sanctuary, covering over four square miles of marsh (Elkhorn Slough Reserve 1998). The Slough contains many habitats, which include uplands, riparian areas, saltmarsh, and mudflats. Each of these areas supports a wide variety of plants and animals. Through time, Elkhorn

Slough has been greatly influenced by human activity which continues to this day. For example, the Slough is faced with severe tidal erosion caused by the opening of the main channel and the building of Moss Landing Harbor in 1947. Elkhorn Slough Reserve is surrounded by heavy agriculture use, including a dairy and commercial farming. Other land uses include: a railroad passing through the slough, a wrecking yard, and power plant. This use of the nearby areas significantly decreases water and soil quality, affecting the health of the animals and plants within the Slough (Elkhorn Slough Reserve 1998). Solutions to these problems are varied, yet one of the most important approaches is effective education. It has been shown that increased direct experiences with outdoor habitats have a significant effect on environmental attitudes and knowledge (Tanner 1980; Finger 1994). Through directly learning about these important habitats and the values they provide, we may be able to teach our children to respect and take care of these tremendously important areas.

In 1998, at the beginning of this study, Elkhorn Slough Reserve did not have an established method for evaluating its school programs. Short- and long-term effects of the program on environmental knowledge and positive environmental behaviors were unknown. The educational staff at Elkhorn Slough Reserve is currently re-evaluating the curriculum and procedures for their school programs. This project was timely in that the results will help the educational staff learn about the effectiveness of their current programs and suggest changes they may want to make. It also will help them identify concepts that are being taught successfully and those which are not. Ultimately, a strong program will give them increased opportunities for funding. The results of this work will

also give the educational staff insight into if and why students make return visits to the Slough with their parents. This information will help determine critical factors in their outreach and marketing strategies, both for the school programs and for the Slough in general.

Our society puts significant emphasis on education. Increasingly it is becoming more important for environmental education to reach all students. They are the future caretakers and each will have an impact; it is up to our educational system to help them learn about the choices they have and the paths they can take. Evaluation can improve environmental programs which are designed to create students who are well informed, motivated, and have the confidence to be able to make good environmental choices throughout their lifetime.

II. RELATED RESEARCH

Evaluation of environmental curricula and programs has been an important topic since the environmental education movement intensified in the 1970s. Researchers have continued to examine and develop methods of evaluation for a better understanding of our success within environmental education. This literature review will examine the theories and methods involved in evaluation. The literature will also be reviewed with respect to transfer of knowledge between children and parents.

Theoretical Framework

Environmental awareness has a long history in the United States, though many would point to Earth Day, 1970 as the beginning of the modern environmental movement (Geller and Lasley 1985; Gigliotti 1993). The modern environmental movement has produced significant changes in society's thinking. According to Catton and Dunlap (1978), in the late 1970s, principles based on the Human Exceptionalism Paradigm (HEP), shifted to a new form of thinking based on the New Environmental Paradigm (NEP). The Human Exceptionalism Paradigm was largely based on humans and their culture and its ability to change, thus making social problems much more solvable. Nature was not included in this paradigm. As our society was faced with greater environmental problems, a change in thinking was required to account for the new stresses. The New Environmental Paradigm integrated nature into society's paradigm and made humans one of many species which were independently linked within a finite

group of resources. Since its introduction, this paradigm has been well documented and studied (Dunlap and Van Liere 1978; Albrecht, Bultena, Hoiberg, and Nowak 1982; Arcury, Johnson, and Scollay 1986; Noe and Snow 1990).

Within this new environmental framework, environmental education has proliferated into new curricula and field programs. Research in this area has now become a distinctive field in which theories are created to help advance and investigate environmental education. Three main theories and research frameworks that have been used within environmental education are: 1) Quantitative, also known as behaviorism or positivism; 2) Qualitative, also known as constructivism, or interpretivism; and 3) Critical science, also known as critical reflective inquiry (Cantrell 1993; Hart 1993; Robottom 1993). These three theories dictate the type of education and research that takes place within environmental education.

The quantitative theory focuses on correct environmental behavior as the end product of environmental education. According to this theory, teaching is based on facts and assumes students are beginning without prior knowledge or conceptual ideas which may bias their learning process. The quantitative theory stems from the natural sciences and thus takes the same approach towards research. Evaluation within the quantitative theory often takes the form of written surveys and an experimental design with treatment and control groups. This approach provides an atmosphere in which the researcher is set apart from the educational process so as to not bias the results. Results are interpreted in a statistical manner and seek to establish a relationship between the product being evaluated and possible pro-environmental behavior (Cantrell 1993; Marcinkowski 1993;

Robertson 1994). This theory is by far the most widely used within environmental education evaluation.

The second theory emphasizes the qualitative approach. This theory does not seek to achieve a measurable end product, but focuses more on the understanding and social aspects of environmental issues. Environmental education is viewed as value-based and the learner is presumed to have previous knowledge and concepts which influence thinking and the acquisition of knowledge. Qualitative environmental education begins with determining what the student already knows and bases the education around these clusters of concepts so that it becomes not only an education of facts but also acknowledges the multidisciplinary nature of environmental education (Driver and Erickson 1983; Brody 1991; Marcinkowski 1993). Unlike the quantitative theory, the qualitative theory is derived from the social sciences and so uses different techniques for evaluation. The researcher is very much a part of the process and the data are collected in subjective manners. Interviews, which make use of pictures as well as questions, and classroom observations are typical. Sample sizes are also typically very small, since the researcher is interested in evaluating different aspects, rather than achieving a quantitative output (Cantrell 1993).

The third theory is the critical reflective inquiry. This theory goes one step further regarding researcher involvement and has been called by Hart (1993, 111) as “action research.” Within this theory, students, teachers, and researchers are all working together in units to create a program which continuously evolves towards providing the necessary knowledge and interdisciplinary concepts for environmental education (Hart 1993).

Although this theory may work well in certain educational situations, it does not lend itself well to an evaluation type of measurement.

Knowledge and Attitudes

Quantitative examination dominates the published environmental education research. Given that there is a large amount of research being done about education which emphasizes pro-environmental behavior as its end product, there is also a need for research to determine what variables influence behavior. Several papers have addressed the connection between environmental knowledge and attitudes and environmental behavior. Borden and Schettino (1979) tested the influence of attitudes and knowledge on environmental behavior for undergraduate psychology students at Purdue University. The researchers found that although attitudes and knowledge did not have a positive correlational relationship, they both contributed to increased environmental actions. This same relationship was also found in Ramsey and Rickson's (1977) study of attitudes and knowledge among high school seniors. This study also suggested that there might be other social variables which would contribute to one's environmental behavior. As the research widened to include other variables which might predict behavior, Sia, Hungerford, and Tomera (1985/86) created an instrument that tested variables which they collected from various research papers to try to understand the complexity behind environmental behavior. Their test participants included a group from the Sierra Club as well as members from an Elderhostel. They found the best predictors in their study included level of environmental sensitivity, perceived knowledge of environmental action

strategies (i.e. eco-based consumerism, legal action, political action), and perceived skill in using environmental action strategies.

In another study to evaluate variables influential to behavior, Hines, Hungerford, and Tomera (1987) performed a meta-analysis on several empirically based environmental behavior research papers and discovered a set of variables which they felt were the greatest influences on behavior. These included knowledge of issues, knowledge of action strategies, locus of control (an individual's perception as to whether or not he or she has the ability to bring about change through his or her own behavior), attitudes, verbal commitment, and an individual's sense of responsibility. Clearly, attitude and knowledge continue to play a large role in influencing environmental behavior.

Finally, Hungerford and Volk (1990) evaluated several behavior models and created their own behavior model based on previous research. They identified three categories which they felt were most important. These categories included entry-level variables (environmental sensitivity, knowledge of ecology), ownership variables (personal investment in environmental issues, in-depth knowledge), and empowerment variables (knowledge of and skill in using environmental action strategies, locus of control). Although it is integrated into ownership and empowerment variables, knowledge and attitude once again play a role in determining behavior.

Survey Instruments

Given that knowledge and attitude are factors which are often found to influence behavior, many researchers conducting quantitative research have created survey

instruments which measure attitude and knowledge. The most well known instrument is a scale by Maloney and Ward (1973), which was written based on verbal commitments (what one would be willing to do), actual commitments (what one has actually done), affect (one's emotionality related to environmental issues), and knowledge (factual environmental knowledge). Verbal and actual commitments were presented in a true-false format. Questions related to affect were written in both negative and positive manners and were randomly mixed. Knowledge items were multiple choice and were presented at the end of the scale. The test was administered to a group from the Sierra Club, a group of lower division psychology college students, and a group of adults that had less than 13 years of formal education. Although the Sierra Club group scored significantly higher on all of the subscales (verbal commitment, actual commitment, affect, and knowledge) and the college group scored significantly higher than the noncollege group, their results indicated that people in general had a high degree of verbal commitment and affect, and lower levels of actual commitment and an even lower amount of knowledge. In 1975, Maloney, Ward, and Braucht refined and shortened their scale, thus making it more practical and efficient. They also wanted to make their scale publicly available. Since then, many researchers have either used part of their scale or have based their own survey instruments on this scale.

In 1994, Musser and Malkus (1994) created The Children's Attitudes Toward the Environment Scale (CATES). This was the first widely published children's scale to test general environmental attitudes. It was written for students between the ages of 8 and 12 years old in a format that is easily understood by students of that age group. This scale

was created using psychometric principles, meaning that the scores can be summed up and interpreted in regards to the beliefs, behaviors, and affect questions on the test. The test also has a good test-retest reliability (meaning that they received relatively the same results when given to the same students over a period of time).

An additional children's scale was created by Leeming, Dwyer, and Bracken in 1995. This scale is called the Children's Environmental Attitude and Knowledge Scale (CHEAKS) and unlike the CATES this scale also measures knowledge in students from grades 1-7. Like CATES, it measures across a wide range of environmental issues and was meant to be used so that comparisons could be made between various studies who use the same scale for evaluation. Part of the development of CHEAKS was based on structure and content from the adult scale created by Maloney, Ward, and Braucht (1975). The CHEAKS scale was extensively pilot tested and the final version consisted of an attitude subscale, a knowledge subscale, and one total scale score which is based off the combination of the attitude and knowledge scores. This final scale was extensively field-tested and was proven to be both reliable and valid in both the subscales and total scale scores.

Experimental Methods

There are a variety of experimental methods used by quantitative researchers. Leeming, Dwyer, Porter, and Cobern (1993) reviewed 34 environmental education studies which attempted to demonstrate changes in environmentally relevant knowledge, attitudes, or behaviors. Fourteen papers showed positive results with increased

knowledge, attitude or behavior after the intervention (in-class methodology or out-door methodologies). Six showed a mixed result, and another fourteen showed either negative results or were studies whose experimental designs were too weak to determine an outcome. Similar issues arose throughout Leeming's review. Only a few papers gathered follow-up data and very few measured students in age groups below fifth grade. The authors emphasized that they hoped studies in the future would develop more research in those areas. They also criticized studies, which did not choose control groups, or if they did, the control groups were not meaningful and valid comparisons could not be made. Many scales that were used to measure attitudes and knowledge were developed by respective authors but did not statistically test validity or reliability. Leeming, Dwyer, Porter, and Cobern (1993) note it is important to either use a previously developed and well tested scale, or if it is adapted or a newly developed scale, it should be well tested on its own. Statistics were also a problem, with authors using either weak or inappropriate statistics. Leeming, Dwyer, Porter, and Cobern (1993) did not approve of researchers using individuals rather than classrooms for the unit of analysis. Using classes as the unit of analysis helps account for the differences that exist between classes. Finally, they also noted "experimenter expectancy." This occurs when the students know what the experimenter is expecting and so may not answer attitude questions completely truthfully but may do so according to what they feel the experimenter would like to hear. This may occur when the same person gives the pre and post exam and/or when the posttest is administered immediately after the intervention.

Leeming, Dwyer, Porter, and Cobern (1993) suggested that the study by Armstrong and Impara (1991) is a good model to follow. Armstrong and Impara (1991) evaluated the impact on knowledge and attitude of a classroom environmental education program called *NatureScope*. This program consisted of classroom materials which covered various environmental topics. Teachers who taught fifth or seventh grade volunteered to participate. Among these classes, those who received one topic served as the control group for a topic they did not receive. Control and treatment groups received both pretest and posttest for knowledge, but the attitude test was only given as a posttest. Armstrong and Impara (1989) had examined the order of attitude and knowledge testing and found that students who were tested for knowledge prior to attitude may have a lower attitude score due to frustrations with the knowledge questions. So, to avoid pretest contamination with the attitude scale, Armstrong and Impara (1991) only looked at how attitude scores differed. They also administered the attitude scale to students who were not involved in the *NatureScope* study. The knowledge scale for this study was pilot tested and statistically tested for reliability, while a panel of educational researchers, environmental education specialists, and topic professionals evaluated content validity. The attitude scale was adapted from existing measures, and the authors used the item analysis from the attitude pilot test to make sure the changes they made did not lower its reliability check. Using the classroom as an unit of analysis, the authors performed analysis of covariance tests (ANCOVA) for the knowledge scale and analysis of variance tests (ANOVA) for the attitude scale. They also used Pearson's coefficient to estimate a correlation between knowledge posttest scores and scores on the attitude scale. The

researchers found that the treatment groups scored higher than the control groups on the knowledge scale, but only one topic was of a significant value. Average scores across grade levels also did not differ significantly. In addition, no significant differences were found among the attitude scales. Leeming, Dwyer, Porter, and Cobern (1993) praised these researchers on three points in their study. They felt the authors used good sampling methodology, developed well-tested measurement instruments, and performed appropriate statistics using each class as the unit of analysis.

Another study which looked at attitude and knowledge change was reported by Fortner and Lahm (1990). They researched the attitude and knowledge change in fourth and fifth graders following a field trip to a National Estuarine Research Reserve site. A quasi-experimental nonequivalent control group design was used for the study. Quasi-experimental refers to the treatment groups which were not randomly chosen, but were chosen from classes who were already scheduled to visit the site. Nonequivalent control groups are expected to produce slight variances due to teacher differences and possible student composition. The authors developed the attitude and knowledge scales; reliability and validity were tested through pilot studies for the knowledge test. They did not state whether the attitude scale was also put through the same tests. The knowledge test asked fact and concept questions and used both words and pictures, which reflects the type of learning the students experienced. This also reflects a combination of quantitative and qualitative evaluation. The researchers did not mention the order of attitude and knowledge questions. Both control and treatment groups were administered the pretest and posttest immediately before and after the treatment. The researchers also wanted to

know at what point in the program was the greatest change in attitudes and knowledge, so they administered a test between their in-class program and before the field trip visit to the site.

Using a t-test for knowledge and attitude, the researchers did see a significant change from the pretest to posttest. One limitation mentioned for this study was that the researchers could not monitor instruction in the classrooms before the visit. A questionnaire was provided for the teachers which asked about their use of materials provided by the estuary. Although material may have been similar, teaching styles were likely to vary. Another limitation was that knowledge and attitudes specific to the estuary were the only aspects tested. Motivation for the subject or long term retention was not tested.

Additional research at another National Estuarine Research Reserve site was designed by Heffernan (1998), who created evaluation methods for that site. Quantitative methods of evaluation were created for adults visiting the exhibit area and students (grades 4-6) visiting the site on a field trip. The author developed a survey with assistance from one of the exhibit designers. Heffernan (1998) mentioned running a pilot test to identify problems within the survey but did not expand any further regarding the pilot test or ways in which problems were identified on the survey. For the adult group, a random number of participants took the pretest and another random group took the posttest. This design prevented internal testing problems since the pretest was not able to cue the participant regarding the posttest. This design was also used for the students, although the students were not selected randomly since the researchers had to use students who had already

scheduled a trip to the site. Heffernan states that she used Cramer's V statistic to measure the effect size, but she did not present any data. A qualitative evaluation was presented as an interview which can be given randomly to students who visit the site. The author created a standardized open-ended question format, so that relationships and effects could be analyzed. She also spent some time reviewing interviewing techniques. Unfortunately, this paper did not elaborate on any results of their evaluations.

Child to Parent Transfer of Knowledge

Only two literature articles were found which addressed environmental knowledge transfer between child and parent. Sutherland and Ham (1992) addressed child to parent transfer of knowledge for sixth graders in Costa Rican families. Several methods of data collection were used, including student and parent interviews, pretesting and posttesting parents, and participant observations within two families. The different methods of data collection were used to compare self-reported data from interviews to data gathered through observation and through the quasi-experimental method.

There were 17 sixth graders used in the study, about half of who lived in rural areas and half in urban areas. Interviews were pilot tested prior to usage. Interviews were conducted with the student and then with the parents. After known environmental information was given at school, parents were then interviewed again. During both interviews, parents were given a pretest and a posttest on a booklet which talked about a local natural resource. This booklet was given to the students in school between the pre- and posttest. Results varied and could not be quantified regarding how much

environmental knowledge was transferred. Often times, knowledge that was transferred was in regard to other subjects. Although many times children viewed themselves as a source of information for their parents, most data suggested that information transfer was a phenomenon common for only certain families. Of the 25 individual parents, 7 claimed that they had learned much through their contact with the children's school work. This included other topics as well as environmental knowledge. There was a change in the parents' environmental awareness throughout the study. During the pretest, only two parents had any knowledge about conservation measures at the local nature site. During the posttest, 18 of the 25 parents were at least minimally aware of the project.

Observations within the family verified few incidents in which environmental knowledge was transferred to the parents from the children. These researchers identified three routes of transferal among the children and parents. One was deliberate transfer, in which a student consciously volunteered knowledge with an intent to teach or change an adult's behavior. The second was inadvertent transfer, in which a student unwittingly shared information which may change an adult's beliefs or behavior. The third was parent-initiated transferal, in which an adult solicits information from a child. The conclusion of these researchers was that transfer of knowledge through school children may not be a dependable or reliable linkage for communicating environmental education to adults, even though it may sometimes occur.

Children's influence on parents was part of a larger study on knowledge and attitude conducted by Leeming et al. (1997). Sixteen classes, grades 1-7, volunteered for the Caretaker Classroom Program in which the classes were asked to engage in a minimum

of eight environmental activities throughout the school year. Control classes not participating in the program were used for comparison. The measurement used for knowledge and attitude was the Children's Environmental Attitude and Knowledge Scale (CHEAKS). In addition, an attitude survey created by Weigel and Weigel in 1978, was used for the parents at the end of the program. The survey also contained a 36-item behavior checklist. When students were administered the posttest, a letter was sent home explaining the study and requesting the parent's help. It also contained the survey, behavior checklist, and a postcard that could be signed and returned to make a commitment "to help make the earth a better place to live." The postcard also had relevant environmental behaviors that they could check appropriately as *do now* or *will do*. The postcards were preaddressed, but did require the parents to put on postage. In their analysis, the researchers used the classrooms as the unit of analysis and each individual parent as the unit of analysis.

For the students, knowledge did not significantly increase, although it was more positive in the treatment group. Attitude change was most significantly a function of grade level. Grades 1-3 showed significantly more positive attitudes than those students in grades 4-6. Regarding transfer of information to parents, the evidence was strong that those students who participated in the program influenced their parents to adopt more pro-environmental behaviors. Parents of the treatment group scored significantly higher on the communications section of the behavior checklist, which dealt with talking about the environment with children, spouse, and neighbors, as well as reading about the environment. The general conclusion drawn by the researchers was that participation in

the program increased parent-child discussions of the environment, and that effect occurred across different ages and levels of involvement. Also, the treatment group parents returned a significantly higher percentage of commitment postcards than did the control group.

Elkhorn Slough Reserve had the need for a well-planned and executed evaluation for its school programs (Parker 1998). The literature review revealed a need for environmental attitude and knowledge research within the younger age groups. It also revealed a paucity of information regarding transfer of environmental information from student to parents. This thesis attempted to fill those gaps. Based on the quantitative analysis framework, a valid and reliable test was adapted from previous sources to statistically measure the environmental attitude and knowledge in fourth graders. Qualitative questions were also devised and added to the survey since these types of questions are partly reflective of the type of programs at Elkhorn Slough Reserve. The scale was pilot tested to assure questions were clear, effective, and could be finished in a timely manner. A quasi-experimental nonequivalent control design was used. Treatment groups were selected from the fourth grade classes signed up to attend school programs at Elkhorn Slough Reserve during Spring 2000. Control groups were chosen for the greatest equivalency from the same schools. Both control and treatment students were given an economic incentive to return to the Slough.

III. OBJECTIVES

This project was designed to answer the following questions concerning the effect of the school programs at Elkhorn Slough on fourth graders:

1. Is there a significant difference in environmental knowledge between students who participate in the Elkhorn Slough Reserve school programs and a control group which does not participate?
2. Is there a significant difference in environmental attitudes between students who participate in the Elkhorn Slough Reserve school programs and a control group which does not participate?
3. What is the visit rate for students who participate in the school programs? Given an economic incentive, what is the visit rate of students who did not participate?
4. Are the parents of students who visited Elkhorn Slough learning environmental information from their children?

IV. METHODS

Introduction

Educational research generally falls into the categories of quantitative and/or qualitative research. Most published program evaluation research tends to be quantitative, due to its objective and statistical nature. Qualitative research does provide information that may be unattainable with strictly quantitative methods. Mixing qualitative and quantitative research methodology allows the researcher to capitalize on the benefits of both procedures.

To answer the research objectives regarding changes in environmental knowledge and attitudes, a quantitative pre- and posttest design was used. To maximize the integrity of the data, qualitative questions were integrated into the teacher questionnaires and parent surveys. All data for this research were collected between April to August 2000.

Study System

During the study period of October 1998 to August 2000, Elkhorn Slough Reserve offered one and a half-day fall and winter training sessions to interested teachers of all grade levels, providing them the knowledge and tools needed to bring their class for a field trip. Field trips lasted for a significant portion of the day (approximately 9:30am-1:30pm) and were led by the trained teacher and other parent and teacher assistants. Elkhorn Slough Reserve staff offered a 15 minute orientation for the classes when they arrived. Teachers were responsible for the program the rest of the day. The school

programs utilized a newly reconstructed interpretive center, which provided large examples of mud habitats, interactive questioning, watershed models, museum style displays, hands-on animal parts, and a large array of local live plants. The goals for the school programs included: the introduction of naturalist skills (observation, binocular use, use of the Reserve), nature appreciation and awareness, basic biological concepts of the Slough, and reducing the fear of animals such as snakes and sharks. There were no fees for the field trip besides transportation fees and the cost of the teacher training workshop (\$25). Treatment classrooms in this study had one field trip to Elkhorn Slough Reserve during the school year.

Population and Sample

Fourth grade classrooms, which had already scheduled field trips to Elkhorn Slough Reserve, were solicited for participation in this research. Fourth graders were chosen for this evaluation for several reasons. First, they constitute a large portion of students who visit the Slough. Second, they are part of the younger group of students that educational researchers have stressed should be targeted due to their long-term environmental capabilities (Leeming, Dwyer, Porter, and Cobern 1993). Finally, fourth graders are old enough to complete a written survey yet are still at an age where they might actively communicate with their parents regarding their school experiences. This last factor was important to help clarify whether students transfer environmental knowledge to their parents.

The sampling for this study was non-random due to the necessity of choosing classrooms which were already scheduled to visit Elkhorn Slough Reserve. Letters explaining the study, reviewing the benefits, and asking for participation in the research were mailed out to the perspective teachers (Appendix B). Benefits to the participating classrooms included receiving the Monterey Bay Aquarium's book about Elkhorn Slough as well as an Elkhorn Slough Reserve poster. It was also mentioned in the letter that the students would be receiving a coupon good for a free family admission onto the Reserve. Along with the letter, teachers were sent a qualitative questionnaire which asked for information regarding their field trip to Elkhorn Slough Reserve (Appendix B). Teachers were asked to explain their scheduled lesson plans for the field trip, as well as any pre and post-field trip lessons. They also listed any other field trips that their class participated in throughout the year. A self-addressed stamped envelope was included for easy return. To maximize participation in the research, letters were sent out to thirteen teachers at eight different schools, regardless of their distance to Elkhorn Slough Reserve. Teachers mailed their questionnaires back indicating their interest in the research. In the end, eleven teachers from six different schools participated in the treatment group. Those two teachers who chose not to participate had canceled their field trip to Elkhorn Slough Reserve due to transportation problems, or had discovered they no longer had the time to take the field trip.

As treatment teachers were contacted to schedule pre- and posttesting times in their classrooms, they were asked to identify potential control teachers (teachers not scheduled for an Elkhorn Slough Reserve field trip) who were either at their school or at a nearby

school. A list of control teachers was gathered and they were sent similar letters and questionnaires (Appendix C). Their letter described the research, benefits involved, and asked for their participation. Additional benefits for control teachers included a scholarship for the Teacher Training Workshop at Elkhorn Slough Reserve valued at \$25. Since control classrooms were not visiting Elkhorn Slough Reserve, their questionnaires focused on issues such as: how much time do they spend per week talking about science/environmental topics, what kind of science topics are taught in the classroom, what types of field trips do they attend during the year, what topics do they focus on during these field trips, and if they were interested in learning more about Elkhorn Slough Reserve field trips. Eight teachers at five different schools participated in the control group portion of this research.

Once contact was made with the teachers, consent letters addressing the parents were mailed to the teachers (Appendix D). Due to the significant portion of Latinas/Latinos within the study, the consent letter was translated into Spanish on the opposite side of the letter, for those parents who did not speak English (Appendix D). This study was approved by the Human Subject Review Board at San José State University with the condition that all participants have parent approval (Appendix D). Three parents called the investigator to clarify questions they had regarding the study. All parents who called were very enthusiastic at the end of the conversation and were willing to sign the consent forms. Generally, the majority of the students (if not all) within the classroom returned their consent forms.

Experimental Design

The experimental design used for this evaluation consisted of a treatment group of students who visited Elkhorn Slough Reserve and a control group which did not. A pre- and posttest design was used to interpret changes in attitude and knowledge. The following diagram illustrates this design:

Group	Pretest	Elkhorn Slough Reserve Visit	Posttest
Treatment	X	X	X
Control	X		X

This quasi-experimental, nonequivalent control design is widely used throughout the evaluation literature (Armstrong and Impara 1991; Fortner and Lahm 1990; Heffernan 1998; Leeming et al. 1997). The name of this design refers to the non-random nature of the treatment and control groups.

In the interest of looking at effects, which were extended versus immediate effects, the pre and posttest were conducted two weeks prior and two weeks after the treatment group's visit to Elkhorn Slough Reserve. Control classrooms were tested at the same time, giving approximately one month between surveys for all classrooms. All surveys were administered by reading aloud all questions and answers on the survey (with the exception of one GATE class which read the survey individually). In the beginning of the pretest, I would introduce myself and explain that I was a graduate student who was interested in the Elkhorn Slough Reserve. The format of the survey was reviewed with

the students before the testing began. It was emphasized that the attitude questions told us how they felt about environmental issues and that there were no incorrect answers to these questions. Conversely, it was explained that the knowledge questions had only one correct answer. No concepts were taught while the students were being tested. The only time any questions were answered for the students was after the posttest was completed. The introduction and administration of the survey took roughly 30 minutes in each classroom.

The second portion of the study, which addressed the return visit rate and child-to-parent knowledge transfer, took place once the posttest had been completed. After the posttest, both the experimental and control groups of students were given an economic incentive for returning to the Slough for a visit with their families. Currently, family members over 16 years of age who visit the Slough are required to pay a day use fee (\$2.50) for use of the Reserve trails. Since economic incentives are favorable to people and were given to students who may never come to the Slough due to financial reasons, one coupon was given to all students at the end of their testing. The coupon gave directions to the Elkhorn Slough Reserve and briefly explained the redemption process (Appendix E). The coupon was redeemable at the Elkhorn Slough Reserve interpretive center through the end of August, 2000, and allowed all family members 16 years or older to explore the Reserve trails for free on that day (up to a \$10.00 value). In return, the parents or guardians would be asked to fill out an appropriate survey (either treatment or control) which was determined by the color of their coupon (Appendix F). Coupons

were color coded for treatment and control group, in addition to having their class code written on the coupon for tracking particular classrooms.

Instrumentation and Data Collection

To evaluate the effectiveness of the Elkhorn Slough Reserve school programs, changes in attitude and knowledge were measured using a survey instrument which was developed by building upon a well-established children's environmental survey. In addition, other questions were written to address topics and themes which the students would be exposed to during their visit at Elkhorn Slough Reserve. This survey partially consisted of general environmental questions used from the published survey CHEAKS (Children's Environmental Attitude and Knowledge Scale) by Leeming, Dwyer, and Bracken 1995. Items from this scale had been statistically tested for validity and reliability. New Elkhorn Slough-based questions were also written and integrated into the survey (Appendix G).

The final scale was pilot tested with fourth graders at Elkhorn Elementary School, which is located near Elkhorn Slough Reserve. This school was chosen because of its proximity to the Reserve and because of its similar demographics to the students who were to participate in the study. Due to the proximity of the school, most students had been to Elkhorn Slough Reserve on a field trip during some part of their schooling, although none of the students had been or were scheduled for a field trip to the Slough that school year. Three classes of fourth graders were administered the preliminary version of the survey by reading it aloud to the students, just as it would be administered

in the research project. At the end of the survey, students were able to ask questions. Their questions were an indication of what they found confusing or didn't understand. These discussions with the students helped to determine specific difficulties with word choices, questions, and test length. Upon completion of the pilot testing, questions were analyzed for word choice, obvious repeated answers, and questions most often left unanswered. Content was then reviewed by Kenton Parker, the Education Coordinator at Elkhorn Slough Reserve, and decisions were made as to what questions should be taken out and modified to improve and shorten the length of the survey. The final testing instrument had 59 total questions (Appendix G). They consisted of: five questions that were student information related, four questions that were practice items for the true/false attitude questions, twenty questions that were true/false attitude questions, twenty multiple choice knowledge questions, and ten multiple choice picture identification questions.

Parent surveys were also developed for this project. Questionnaires were written separately for the control group and treatment group of parents (Appendix F). These questionnaires were all qualitative questions centered on their visit. The treatment group questionnaire focused on their reason for visiting, their child's field trip and whether they had learned anything from talking with their child about the field trip. The control group questionnaire focused on their reason for visiting, asked if they discuss environmental topics with their children and asked how often they visited outdoor places.

Analysis

Original scores were coded with numbers associated with their answers and entered in a SPSS database. Attitude scores were collected as true/false answers, and so their coding was either 1 or 0. Knowledge scores were collected as either A, B, C, or D, therefore the data was entered as either 1, 2, 3, or 4. Once the database was complete, the data was recoded to reflect either the most pro-environmental attitude, or the correct answer in the knowledge section. Environmental answers and correct answers received a score of "1" and lesser environmental answers and incorrect answers scored "0". The highest possible score for the attitude section was twenty, while the highest possible score for the knowledge section was thirty (twenty reading questions, ten picture questions).

The unit of analysis was designed to be the classroom, instead of using individual scores in the analysis, as suggested by numerous studies (Armstrong and Impara 1991; Leeming et al. 1997). Due to this type of analysis, individual students were not tracked from pre to posttest. Instead, an attitude sum and knowledge sum was calculated for each student, for each test (pre and post). The data were then aggregated onto a separate data file which took the individual student scores and created pretest and posttest classroom means which were used in the tests of significant differences.

In the critical review written by Leeming, Dwyer, Porter, and Cobern 1993, it was stated that a problem with many previous studies was that they often did not include both the pre and posttest measures in a single analysis. They also noted that simply comparing posttest scores between treatment and control after establishing a nonsignificant difference between the pretest scores of the treatment and control was not appropriate.

Due to these issues, an one-way analysis of covariance (ANCOVA) was the preferred method of analysis for this data.

An ANCOVA was conducted to evaluate the change in attitude between the treatment and control classrooms. In the ANCOVA, pretest data from both treatment and control groups were used as the covariate, which created an adjusted mean for comparison. The posttest data from the treatment and control groups were used for the dependent variable. Different fixed factors (treatment/control, language, distance to the Slough, visits to the outdoors) were chosen for the determination of significance (Green, Salkind, and Akey 2000). Significance in this research was measured at the $p < .05$ level.

To determine significance between pre and posttest data within individual classrooms, independent t-tests were used with individual student data (either attitude or knowledge) as the variable and pre and posttest as the grouping variable (Green, Salkind, and Akey 2000; Fox 1998).

To graphically view the data, bar graphs were created using classroom means. For greater understanding of the data, boxplots were produced also using the classroom means. Boxplots display the range of the data, including outliers, and indicates the 25th, 50th, and 75th percentiles. The whiskers of the boxplot represent the smallest and largest scores that are not outliers. Outliers are defined as values that fall between 1.5 and 3 box lengths from the upper or lower edge of the box. Comparing the median values (50th percentile) aids in understanding where the scores fall in relation to other boxes on the plot (i.e., which have more high or more low scores). It also provides a clear picture

regarding the skewness of the data (Green, Salkind, and Akey 2000; Sokal and Rohlf 1995).

V. RESULTS

Student Information

Eight hundred and eighty surveys were gathered from eight different schools during the pre and posttest data series. Surveys were collected in eleven treatment classrooms and eight control classrooms. Since the unit of analysis was the classroom, individual students were not tracked from pre to posttest. Student profiles are listed in Table 1. An almost equal number of girls and boys took the pre and posttest survey. For the posttest, most students (77%) noted that their first spoken language was English, with 13% of the students reporting Spanish as their first spoken language. When asked if they read books about nature, roughly 84% replied “yes”, while 14% said “no”. A slightly greater majority of students replied that they watched nature shows on TV (87%). Students were also asked how many times in a month they visit an outdoor area (park, beach, mountains), and roughly 46% replied five or more times per month. Visiting an outdoor area one to two times per month had the next highest percentage (26%), followed by three to four times per month (23%). Three percent of the students reported that they never visit outdoor areas.

Attitude

The pretest mean attitude score for the control group was slightly higher than the treatment group's mean pretest score (15.44 and 15.22, respectively) (Figure 1). The

posttest for both groups detected an overall decrease in attitude mean scores. The range within the pretest scores was larger in the control group than in the treatment group, with the exception of the treatment group's outlier (Figure 2). The control group also had a higher pretest median score, showing more high pretest scores compared to the treatment group's pretest scores. This trend changes in the posttest scores as indicated by the higher median score of the treatment group. Besides the outlier, the whiskers of both groups indicate that the control group had the lowest posttest scores and the treatment groups had the highest scores on the posttest.

Pretest and posttest attitude scores were compared with an one-way analysis of covariance (ANCOVA). In this ANCOVA, classroom type (treatment or control) was used as the independent variable. The dependent variable was the posttest attitude mean score for each classroom and the covariate was the pretest attitude mean score for each classroom. The ANCOVA for attitude was shown to be not significant ($p = .601$) (Table 2).

To examine individual classroom scores, t-tests were run on pre and posttest attitude scores for each classroom. It was shown that only one treatment classroom out of all treatment and control classrooms had a near significant change in attitude score ($p = .053$). Individual questions were also tested for a significant change with a t-test. Only two attitude questions showed a significant change from pre to posttest for all treatment classrooms. One question pertained to water use ($p = .045$) and the other was about the worries of farm run-off ($p = .025$).

Knowledge

Both treatment and control groups had pretest scores which were fairly close, although they were a bit higher for the treatment groups (15.25 and 15.11, respectively) (Figure 3). The posttest scores for both groups showed an increase in knowledge mean scores, although the treatment groups had a greater increase with a posttest knowledge mean score of 17.63 as opposed to the control mean of 16.43. With the exception of the outliers in the treatment group, the range of the control group's pretest knowledge scores showed some of the lowest scores when compared to the treatment group's range of scores (Figure 4). The control group's median is higher, indicating a larger number of high scores, even though the treatment group had the highest pretest knowledge scores. In the posttest, the control group had a more narrow range of scores, while the treatment group showed a wider range of scores. Both groups in the posttest had outlier classrooms, with the control groups having a low outlier and the treatment groups having a high scoring outlier. Besides the outliers, the treatment group's wide range included the highest posttest scores and some scores that were the lowest between both groups.

A one-way analysis of covariance (ANCOVA) was conducted to evaluate the change in knowledge between the treatment and control classrooms. Classroom type (treatment or control) was used as the independent variable. The dependent variable was the posttest mean knowledge score for each classroom and the covariate was the pretest mean knowledge score for each classroom. The ANCOVA for knowledge was shown to be significant ($p = .044$) (Table 3).

To identify individual classrooms which had a significant change in knowledge, t-tests were run comparing pre and posttest student knowledge means for each classroom. It was shown that six treatment classrooms had a significant increase in knowledge while no control classrooms had a significant change in knowledge. Within those six classrooms that had an overall significant change in knowledge, no single classroom stood out as having a large number of questions which had significant changes between the pre and posttests. One classroom had six significant questions, while the others had five, four, and three questions with a significant change.

To understand if particular questions more often had significant changes, questions were separated into those which scored a significant change in at least one classroom and those which never had any significant change. Twelve out of the twenty multiple choice knowledge questions had classrooms which scored significant differences. Of those twelve, nearly all questions only had one, two, or three classrooms in which there had been significant changes. However, one particular question (#18) had a significant change in seven out of the eleven treatment classrooms. This question was pertaining to the history of Elkhorn Slough. Since such a discrepancy existed between the number of classrooms which had this particular question significant, as opposed to the other eleven questions, an additional analysis was done to determine how this single question was influencing the overall significant change in the knowledge score. A second ANCOVA was run for knowledge with means which did not include question eighteen. The results showed that there was no longer a significant difference between the pre and posttests for knowledge ($p = .115$) (Table 4). Using t-tests to analyze individual classrooms with

means that did not include question eighteen, the number of classrooms with significant changes in knowledge decreased from six to five.

The final section of the survey was ten pictures of seven animals and three plants. Students were asked to decide the habitat in which these plants or animals lived. Out of the ten questions, six had significant differences for at least one of the classrooms. The mouse, plankton, and poison oak each had one significant change. Three classrooms had significant changes for the pickleweed and the fat innkeeper worm. The question regarding the habitat of the snake had the largest number of significantly different classrooms, with six.

Gender

Differences in attitude and knowledge between the boys and girls within the treatment and control groups were analyzed. With attitude, girls in both control and treatment classrooms had a higher pretest attitude mean score (more environmental) than their boy counterparts (Figures 5 and 6). In both control and treatment groups, the posttest attitude scores for boys and girls were both lower (less environmental) than their pretest score. The smallest change from pretest to posttest was seen in the treatment groups for girls. The attitude changes displayed by gender between the two groups were not significant (boys $p = .748$, girls $p = .431$).

Range in attitude scores between boys was slightly smaller in the control group than in the treatment pretest scores (Figure 7). The pretest median for the control group is higher than the treatment group's indicating a greater number of high attitude scores. The

treatment group range includes the lowest attitude scores between all the boy's pretest scores. In the posttest, the control group generally held the same wide range, although their scores decreased as indicated by their lower median score. The range for the treatment group boys' posttest scores decreased. This smaller range shows that attitude scores for the treatment boys were not as high and, besides the outlier, were generally not as low as in the pretest.

For girls, different attitude range trends were found (Figure 8). The pretest ranges between the girls' treatment and control groups were very similar. Although the higher median for the treatment group represents more high scores and the lower whisker for the control group indicates the lowest scores between the two groups. The range differences between the two groups increases for the posttest scores. The control group's posttest scores show a median that was raised, showing more high scores than in their pretest scores. However, their posttest variation displays lower scores than were seen in their pretest. The posttest scores for the girls' treatment groups decreased in range while their median score increased showing many more high scores. The girls' treatment group had an overall decrease in the posttest means, explained by the low outliers in Figure 8.

When examining knowledge, boys and girls in the control groups had similar pretest scores, while in the treatment groups, girls had higher pretest scores than boys (Figures 9 and 10). Although the change in the control group's mean knowledge scores were not significant, there was an increase in the posttest score, with the boys achieving a higher posttest score than the girls (Figure 9). Posttest scores for the treatment group indicated the girls also ended with a higher score than the boys (Figure 10). The knowledge

changes displayed by the boys between the two groups were not significant (boys $p = .658$). The knowledge changes displayed by the girls between the two groups were significant as indicated by the ANCOVA ($p = .009$) (Table 5).

The control boys' knowledge scores showed a higher median than the treatment boys' pretest median, indicating there were more high pretest scores for the control groups (Figure 11). The whiskers of both groups indicate that the control group had the lowest pretest scores, while the treatment group had the highest scores. These same trends are shown in the posttest scores, with the control groups having a higher median, thus more high scores than the treatment groups. The control groups had the lowest posttest scores, while the treatment groups had the highest posttest scores.

For the girls, the control group had a narrower pretest range and a lower median score indicating more low scores when compared to the treatment group (Figure 12). The whiskers for the treatment groups pretest scores show higher and lower scores when compared to the control groups. On the posttest, the control group's scores showed a lower median than the treatment group's posttest median, indicating more lower scores. The treatment group's posttest scores showed a similar trend to the pretest; a wider range than the control and with the exception of the control outlier, higher and lower scores.

To further analyze the knowledge scores, boys and girls scores were re-calculated to exclude question #18 which strongly influenced the significant difference in the general population of scores. When the girls' scores were re-calculated, it was found that they continued to have a significant difference in knowledge growth, as indicated by the

ANCOVA ($p = .040$) (Table 6). As was expected, the boys' change in knowledge remain nonsignificant ($p = .807$) (Table 7).

Language

The student's first spoken language was assessed during the pre and posttest surveys. Since some students testing results might have been influenced by their English language abilities, an ANCOVA was done to evaluate any differences between native languages and the treatment and control groups. Treatment and control classrooms had relatively similar numbers of secondary English language learners (posttest surveys reporting 13% and 14.2% respectively). The results of the ANCOVA show there was no significant differences in attitude and knowledge scores for different student languages between the treatment and control groups (attitude, $p = .388$; knowledge, $p = .579$).

Distance from Elkhorn Slough

All treatment and control classrooms were broken down into three distinct distances from Elkhorn Slough Reserve (Table 8). It was thought that classrooms closer to Elkhorn Slough Reserve may have had more opportunities to visit at another time, thus may have differences in attitudes or knowledge. An ANCOVA was performed to evaluate any differences in attitude or knowledge scores between the control and treatment groups for schools that were different distances from Elkhorn Slough Reserve. There was no significant difference for attitude or knowledge between these groups of students (attitude $p = .606$, knowledge $p = .284$).

Visits to Outdoor Places

Students were asked about their frequency of visits to outdoor places (ex. park, beach, mountains). Categories of activity per month were: "5 or more times", "3-4 times", "1-2 times", and "never." An ANCOVA was performed to evaluate whether those students who were already actively visiting outdoor locations scored differently than those students who were not outdoors prone. No significant difference was found with attitude or knowledge scores between the student's activity levels and the treatment and control groups (attitude $p = .801$, knowledge $p = .299$).

Teacher Questionnaire

Teachers were asked to return a qualitative questionnaire to show their interest in participating in the project. Questionnaires were different for treatment and control groups. The treatment group's questionnaire focused on Elkhorn Slough Reserve related questions. Teachers were asked about the subjects their class would be focusing on during their fieldtrip. In addition to visiting the interpretive center and going on a hike, most teachers mentioned working with owl pellets, learning about plankton, different habitats, and plants. Other topics of interest included: learning about the food cycle and interdependence, animal tracks, tides, birds, vertebrates and invertebrates.

Pre and post field trip activities were also described. Many teachers mentioned learning about wetlands in general before the field trip through readings, activity sheets, slides and videos. Teachers also wrote about teaching students to identify plants and

animals, in addition to learning about birds (some through hands-on activities) and learning to identify slough birds. Others talked about teaching students about observation and how to record observations.

Post field trip lessons also varied. Teachers held discussions and answered questions about the field trip. Many classrooms also completed art and writing projects that pertained to Elkhorn Slough Reserve. One teacher took the opportunity to start a new unit on water and another chose to do a unit on tides. Other activities chosen by classrooms were further exploration into Slough activities, videos, student research, a quiz, and learning about environmental stewardship.

Control teacher questionnaires focused on subjects and time spent in the classroom on science topics. Answers to the question regarding how much time per week was spent on science topics in the classroom, varied widely from: “very little”, “five minutes”, to “two to three hours per week.” Their topics in science also covered many subjects including: plants, animals, geology, light, and magnetism. Teachers were also asked what field trips they made and what subjects they focused on during the trips. Most teachers went on field trips pertaining to the science or social studies that they were doing in the classroom. Most classrooms went on two field trips throughout the year, while some classes went on several.

Student Return Visits

At the end of the posttest period, all students (treatment and control groups, roughly 440 students total) received a coupon which would allow their family (up to five adults)

to visit and hike on the Elkhorn Slough Reserve for free. These coupons were handed out in May and June and were valid through the end of August, 2000. No coupons were returned during this period. Redemption of the coupons would have asked the parents/guardians to fill out a survey asking them questions about their child's field trip and/or about the reasons they chose to visit Elkhorn Slough.

VI. DISCUSSION

Elkhorn Slough Reserve's education program was evaluated using fourth graders as subjects. Control and treatment classrooms were used to look at changes in knowledge and attitude associated with a one-time field trip to the Slough. The survey instrument used on the students within the eleven treatment classrooms and eight control classrooms provided information on their gender, first spoken language, and some of their nature activities. Comparisons between the treatment and control groups show that both groups were similar in almost all of these demographic aspects.

Attitude

The average attitude pretest score for the control group was slightly higher than the treatment group's average score. The posttest scores for both groups showed a decline in attitude score (less environmental attitude), achieving the same score (15.20 out of a possible 20 points) (Figure 1). The higher pretest survey scores for both groups may indicate experimenter expectancy on the part of the students. Although the survey was introduced as a graduate student research project for Elkhorn Slough Reserve and was emphasized that the interests were in how they felt about the environment and that there were no "right or wrong answers," students still may have felt they needed to answer in an environmentally positive manner. Students were told that I would return, but they were not told that they would be given the same test. This experimenter expectancy may not have occurred on their second time taking the survey because they were familiar with

the survey and less apt to stress a higher environmental attitude when repeating the survey. Therefore, the lower posttest scores may be a truer indication of their real attitude towards the environment.

The boxplot for the attitude scores provided a greater understanding of these data (Figure 2). When comparing the pretest and posttest scores for both groups, the posttest scores had a much greater spread. This may indicate a greater honesty on the posttest, with more low and high scores. When the median scores for the control groups are compared, the score decreases on the posttest, showing that there were a greater number of lower scores in the posttest than the pretest. The median scores for the treatment group are very similar between pretest and posttest, although with the increase in range, the treatment group had higher and lower scores on the posttest. Figure 2 also displays outliers in the treatment groups. These outliers greatly contributed to the lower scores in Figure 1 for the treatment group's mean scores.

Neither control nor treatment groups showed any significant change in pretest and posttest attitude scores. In general, both control and treatment groups showed a fairly high attitude score for both the pretest and posttest. Since the Elkhorn Slough education program is generally not geared towards changing attitudes, seeing a significant change in attitude would need to be preceded by a strong emphasis in this area. Previous studies have shown that there is not a significant change in attitude unless attitude changes are targeted through program length and/or teaching activities and concepts (Shepard and Speelman 1985/86; Knapp 1996; Bogner 1998). At Elkhorn Slough, the curriculum that the teachers received during training focused on factual information and activities

regarding the Slough. Teachers are generally more concerned about the students learning the facts, as opposed to attitude issues. To see a change in attitude, students might need to feel and learn about their connectedness to these places, creating a sense of ownership and empowerment (Hungerford and Volk 1990). If students can develop an ongoing relationship to an outdoor place, we may see them change their attitude towards the environment.

When t-tests were done in each individual classroom to test for a change in attitude, only one treatment classroom had a near significant change in attitude score ($p = .053$). To help explain this, the teacher's questionnaire was reviewed. Out of all the questionnaires, this particular teacher was the only one who mentioned "environmental stewardship" as a post field trip lesson. Most other lessons focused on factual information from Elkhorn Slough Reserve. The word "stewardship" contains many ideas which are needed in order to change attitudes. It is a sense of responsibility and the feeling that we have the power to make things change. Teaching this concept as a post field trip lesson may have provided what was needed to make such a large attitude change in this one classroom.

Specific questions were analyzed for significance in the attitude section, and only two questions were found to have a significant change from the pretest to the posttest for two of the treatment classrooms. One of these questions related to the amount of water that people use and whether it made them upset when they saw people use too much water. This question does not directly relate to Elkhorn Slough Reserve, but instead is a more general environmental question. The other question with a significant difference asked if

the students were worried about farm run-off that may be going into the ocean. The two classrooms which had significant differences with these questions were from the same school and were both on the same field trip. These issues may have been addressed specifically with these groups of students. Both classrooms were from the Central Valley in California and may be more sensitive and knowledgeable about water issues. In addition, they both had studied wetlands as pretest and post lessons for the field trip. Visiting Elkhorn Slough Reserve may have addressed these water issues that related to their studies.

Knowledge

The control group had a smaller average pretest score than the treatment group, although they were within a half point of one another. Both groups showed an increase in their average knowledge score with the posttest (Figure 3). The gap between the control and treatment's posttest scores was wider, with a greater than one point difference. This growth for the treatment group proved to be a significant difference ($p = .044$).

The variation of these knowledge scores is shown with a boxplot (Figure 4). The median indicates more high scores for the control group although the top whisker and outliers on the pretest treatment plot indicate the highest and lowest scores occurred within this group. This variation in scores for the control group narrows for the posttest scores. It was apparent in the control classrooms through some moans and puzzled looks, that students clearly had not been exposed to much of the material. These slightly higher,

less varied posttest control might be explaining a few things. First, some of the students may have looked up some of the answers to the questions after the pretest. Second, it is possible, that some of these issues were discussed in class after the pretest. This narrowing in range is unlike the treatment group's posttest scores which had a higher and wider range to their scores. Given their field trip, in addition to any pretest and post field trip lessons done in class, the treatment students had more experiences to pull from which would account for these higher scores.

When statistical tests were done, it was shown there was a significant difference in knowledge for the treatment group. This significant difference is presumed to have been caused by the field trip which those students attended at Elkhorn Slough Reserve. Since similar factual information is found in the teacher training and in the interpretive center of the Slough, we might expect to see this significant increase in knowledge.

Out of the twenty, non-picture knowledge questions, twelve had at least one classroom score a significant difference. Of interest, was one question which seven out of the eleven treatment classrooms scored a significant difference. This question asked about the previous use of Elkhorn Slough before it became a reserve. Reviewing the teacher questionnaire revealed that this topic was not mentioned in any of the pretest or post field trip lessons, although classrooms would have been able to learn about the history of Elkhorn Slough in the interpretive center. Since there is strong evidence of the history of the Slough as you walk the trails, it is very likely that students were able to readily infer from the surroundings that the Slough was a dairy before it became a reserve. According to the teacher surveys, teaching about Elkhorn Slough Reserve's

history was not one of the main goals for these students, although it was good to see that students were observant enough to learn this fact. While it was clear that more classes had a significant change in this particular question, it was realized this could be unduly influencing the significance of the treatment groups as a whole. This caused a re-evaluation of the data regarding knowledge. To analyze the influence of this one question on the overall significant difference, new class means were calculated without this single question. With these adjusted means, it was shown that the treatment group no longer had a significant difference in knowledge ($p = .115$). This one question was found to push the treatment classrooms' scores to a significant change. Although it is valuable to know the students are picking up on this topic, it is not the main focus of the education program at the Slough. Therefore, the original significant change in knowledge was not considered as notable growth in environmental Elkhorn Slough knowledge.

If we look at the classrooms which had significant changes in knowledge and analyze the number of questions classrooms had significant, no one classroom stood out as having an large number of questions with significance. The classroom that had the highest number (6 questions as opposed to 5, 4, and 3) was a Gifted and Talented Education (GATE) classroom. Although they had a high number of significant questions, it was not largely different from the other treatment classrooms.

Knowledge Questions-Specific Information

Looking at the change in all knowledge questions allows us to better understand what the students already knew, what they learned, and what they did not learn. In the

knowledge portion of the survey, there may have been different reasons for non-significance. The knowledge portion of the survey was composed of both general environmental questions (4), and questions that were directed at Elkhorn Slough (16) (refer to Appendix G). Three of the four general environmental questions did not have any significant change in any of the treatment classrooms. The reasons for non-significance are different for each question. For instance, the question about where garbage goes, was correct roughly 50% of the time for both pretest and posttests. The next question, about who environmental problems threaten, was answered correctly by most students on both the pretest and posttest, resulting in no net change. In the third general environmental question about which items could not be recycled, the percentages were about 60% incorrect answers and 40% correct answers for both pretests and posttests.

There were five knowledge questions relating to Elkhorn Slough in which no classrooms ever showed a significant change. Three of these five questions did not show a significant change because the majority of answers were incorrect for both tests. These three questions were: (1) "What does the word 'watershed' mean?", (2) "What animals can live in a mudflat?", and (3) "The land which surrounds Elkhorn Slough has many uses. What are some of these uses?". One of these five questions showed no significant change because the majority of the students chose the correct answer for both testing times. This question was: "Which of these statements is TRUE about a saltmarsh?". Finally, one out of the five questions showed no change because the students answered correctly roughly 50% for both tests. This question was, "What does biodiversity mean?"

The final portion of the knowledge section was composed of plant and animal pictures whose habitats needed to be identified by the students. Four of the ten questions did not have any significant changes. These were: the jellyfish, moon snail, salt grass, and shark. Three of these plants and animals had a large percentage of correct answers for both the pretest and posttest, therefore they did not display any significant change. The moon snail had roughly 60% correct and 40% incorrect. These percentages did not change between pretest and posttest, resulting in no significant change.

Gender

In both control and treatment groups, girls had higher attitude scores than boys (Figures 5 and 6). This is similar to what was found in other studies (Bogner and Wilhelm 1996; Zimmerman 1996). Although both genders' attitude scores decreased on the posttest, the treatment girls dropped less than the control girls' groups, as well as the boys in both groups. The treatment girls' posttest scores show a higher median and wider range than in the pretest scores (Figure 8). The outliers in Figure 8 had a large affect on their mean, providing for the decrease in the posttest means (Figure 6). Attending the field trip to Elkhorn Slough may have helped the girls maintain this overall high level of attitude.

The higher attitude scores for the girls maybe indicative of many things. First, regarding attitude, given our general societal perceptions, girls may have been taught to better express the way they feel. With the affect type questions which ask, "I get angry...", "It makes me happy...", "I get upset...", "I am frightened...", and "I do not

worry...”, students have to be prepared to provide incite into how they are feeling. Girls may have more practice in identifying with these feelings. In addition, the girls generally had higher knowledge scores. This may indicate a greater interest in the subject matter, which could coincide with these higher attitudes.

In knowledge, the control groups’ boys and girls both started with similar pretest scores and both increased their scores on the posttest (Figure 9). This was unlike the treatment group’s scores, with girls having a higher pretest and posttest mean than the boys (Figure 10). The range of scores for the boys was similar between groups (Figure 11). The median scores on both of the control groups tests reflected more high scores, although the treatment boys had some of the highest scores. For girls, the median trends were different, with the control groups having a lower median, thus more lower scores (Figure 12). The treatment groups showed more high scores. Although both genders had higher posttest scores, girls had more high knowledge scores after the field trip. The ANCOVA showed that both with and without question #18 (history question), girls had a significant change in knowledge (Tables 5 and 6), while the boys were not significant in either case.

The higher knowledge scores of the girls may indicate that the structure of field trip learning could be more responsive for girls than boys. This topic varies in the literature between having reports that girls score higher in knowledge and attitude and other reports which boys scored higher in knowledge and attitude. The fact that girls scored much higher and had higher attitude scores should be noted so that teachers are aware of this fact and can focus on this issue in their teaching.

Language

The primary language composition was very similar between the control and treatment groups. When scores between languages were analyzed, there were shown to be no significant differences. Although control and treatment groups were made up of at least 11% native Spanish speakers, all classrooms were English speaking classrooms. Even classrooms which had a larger majority of native Spanish speakers were transitioned to English at the time of the testing. Although classrooms were English speaking, throughout the testing it was apparent there were some students who had did not have a high level of English skills (students and /or teachers translated at times). Even though there were not a large number of these students, it should be considered that the type of learning which occurs at Elkhorn Slough Reserve field trips may actually be very appropriate for students learning English. The combination of hiking the trails and walking through the visitors center provides students visual, tactile, kinesthetic (body movement), and auditory learning opportunities. When these opportunities are combined with language, it may enhance the learning for these second language students.

Distance from Elkhorn Slough Reserve

Since schools were located a variety of distances from Elkhorn Slough Reserve, an analysis was done to look at attitude and knowledge differences between these groups (Table 6). It was possible that the groups closest to Elkhorn Slough Reserve (10-25 miles) had a greater likelihood of visiting the Slough during other times of their

education, giving them an advantage with the knowledge questions. In addition, since Elkhorn Slough Reserve is a local destination, these students had a greater probability of visiting Elkhorn Slough Reserve on their own with their parents prior to this research. When tests were done, there was no significant difference found between these three groups of schools. This indicates that the groups who live closer to Elkhorn Slough Reserve did not have a significantly different amount of Slough knowledge than the other groups who did not live as close.

Many reasons may exist for this nonsignificant difference in knowledge. First, although students may live close to the Slough they probably rarely visit the Reserve with their families. In fact, the results from this research help support this assumption. It could be the remote location, financial burden, and/or the lack of structured activities which lead to few visits. Second, students may be visiting the Slough with either their parents and/or with their class (at various times of their schooling), but the visit did not have lasting knowledge effects.

Visits to Outdoor Places

It has been shown by Tanner (1980) and Finger (1994) that increased experiences in the outdoors may increase environmental behaviors. Since attitude and knowledge are components of behavior (Hungerford and Volk 1990; Hines, Hungerford, and Tomera 1987), it was possible there would be an attitude and/or knowledge difference between students corresponding with the number of visits to outdoor places. When tested, there was not found to be a significant difference. In this research it was reported that the

majority of students visited the outdoors five or more times per month. Lower percentages visited 1-2 and 3-4 times per month, but these different experiences did not cause a significant difference in attitude or knowledge. A reason for this may have been due to the duration and (how often) of these outdoor experiences. To see a significant difference due to outdoor experiences, those experiences may need to be weekend, or week long trips in a wilderness area or they may need to have a greater number of experiences.

Teacher Questionnaire

Teacher questionnaires were given to both control and treatment classrooms. All information was qualitative and all but one treatment classroom returned their questionnaire. To greater understand those classrooms which had significant changes in knowledge, information regarding pretest and post field-trip lessons were compared between classrooms with significant changes and those who did not have a significant change. For those classrooms that did have a significant change in knowledge, pre field-trip activities and curriculum noted on the questionnaire were varied both in breadth and depth of subject matter. Activity sheets, slides, and hands-on activities were all used to teach a broad overview of general wetland habitats. One teacher emphasized a topic (birds) with other units such as "Structures of Life." Large units on plants and animals were also used before the field trip. In classrooms that did not show significant knowledge differences, teachers wrote that they "discussed" many different topics including: habitats, plants, and animals. Some also mentioned showing videos or films.

This discrepancy in pre field-trip lessons between significant and nonsignificant classrooms provides insight into possible reasons for their success.

Regarding post field-trip lessons, those classrooms which had significant changes in knowledge tended to move into different teaching units (water, tides) in addition to incorporating art, writing, and in some cases, individual research, videos, a quiz, and environmental stewardship. Those classrooms without a significant difference, focused on “discussions” with some art and writing involved. One classroom showed a video that was viewed previously before the field trip.

Almost all treatment classrooms had knowledge questions which showed a significant classroom change. Most treatment classrooms also had knowledge picture questions that had significant changes. These individual questions were looked at in comparison to the pre and post field trip lessons that their teacher wrote about on the questionnaire. Lesson topics were generally broad, and there were no clear relationships between lessons taught and the students getting those particular questions correct.

The classrooms that did have a significant change in knowledge also had more involved pre and post field trip lessons in the classroom. The variety of lesson types and subjects increased and reinforced the information that the students learned from the Slough. Since most questions which had significant changes did not directly relate to the materials they were using in the class, it is most likely a combination of classroom activities and the field trip which lead to the significant changes.

Student Return Visits

Although roughly 440 coupons were handed out to students at the posttesting period, no students returned for a visit with their families. This is a strong indicator of several issues. First, in order for a fourth grader to visit Elkhorn Slough Reserve, the child needs to convince the parent of its value and interest. The lack of visits may indicate that the field trip, or simply learning a little bit about the Slough in the case of the control group students, did not make a significant impact on the students. Second, the financial incentive of a coupon was not enough to bring students and families to Elkhorn Slough Reserve for a visit. Other incentives will need to be researched. Finally, no return visits might indicate that valuable information regarding the environment and Elkhorn Slough Reserve are not being transferred to the parents. If some information is being transferred, it did not appear to peak the interest of the families enough to bring them to visit on their own time.

VII. CONCLUSIONS AND RECOMMENDATIONS

Elkhorn Slough Reserve currently provides one and a half-day training sessions for teachers who would like to participate in the education program. This program focuses on Elkhorn Slough Reserve factual information and field trip ideas, in addition to logistics and rules. Since teachers are leading their own field trips, each field trip varies according to classroom curriculum, the teacher's educational background and the experience of the teacher. Using a comprehensive survey, data was gathered to answer major questions.

Conclusions:

#1. Is there a significant difference in environmental knowledge between students who participate in the Elkhorn Slough Reserve school programs and a control group which does not participate?

There was found to be a significant difference in environmental knowledge between students who did participate in the Elkhorn Slough Reserve school programs and those control students who did not participate. Upon further examination, it was found that the significant results were affected by one particular question regarding the history of the Slough (question #18) and did not include a broad growth in knowledge. Girls did show a significant change in knowledge, even when question #18 was excluded. However, this trend was not seen with the boys.

#2. Is there a significant difference in environmental attitudes between students who participate in the Elkhorn Slough Reserve school programs and a control group which does not participate?

This study found no significant difference in environmental attitudes between students who participated in the Elkhorn Slough Reserve school program and the control students who did not participate. One individual classroom did have a near significant change in attitude. Upon examination, this class was found to be the only classroom which taught environmental stewardship as a post field trip lesson. When broken down, gender groups did not show any significant changes in attitude.

#3. What is the visit rate for students who participate in the school programs? Given an economic incentive, what is the visit rate of students who did not participate?

During this study, the visit rate for both students who participated in a field trip and those who did not participate were equal, with no students visiting Elkhorn Slough Reserve after their posttest. This may indicate several things. First, going on the Elkhorn Slough Reserve field trip did not create enough interest to warrant a return visit. Second, any student excitement gathered from the field trip was not effectively delivered to the parents, therefore providing no incentive for a family trip to Elkhorn Slough Reserve. Finally, the economic incentive was not enough for either the students who did attend the field trip nor for the students who did not attend the field trip. It is unknown whether the coupons were not valued to the student, thus never making it home to the parents, or whether the incentive was not great enough for the parents.

#4. Are the parents of students who visited Elkhorn Slough learning environmental information from their children?

This objective was unable to be met due to the lack of students returning to visit Elkhorn Slough Reserve. It remains unclear what information students may be transferring to their parents upon return from an Elkhorn Slough Reserve field trip.

Recommendations:

Attitude

One treatment classroom in this study approached a significant change in attitude. Upon examination of the teacher questionnaire, it was found that this teacher focused on environmental stewardship as a post field trip curriculum. Learning about stewardship involves understanding environmental connectedness, and gaining a sense of responsibility and awareness towards the environment. In addition, it has a locus of control component, i.e., the feeling that one person can make a difference. To be effective, necessary skills need to be learned to follow through with this new sense of responsibility. If teachers are going to feel comfortable teaching stewardship, they need to be trained in this area. Extending the Elkhorn Slough Reserve curriculum is necessary to include information which can help teachers teach an awareness and connectedness that the students must feel, before they can walk away gaining an understanding of stewardship. Besides being outlined within the curriculum packet, these principles and ideas can be easily discussed during the teacher training period. Environmental attitude

'platforms' can also be used as a way to develop a complete lesson which teaches not only the factual information, but also the skills and necessary stewardship. Providing the students a connection between their everyday environments/habits (school, home) and Elkhorn Slough Reserve, may help the students understand their influence on these natural habitats and how they can take part in protecting them. This would not only lead to a change in attitude, but might also lead to positive change in environmental behaviors.

Knowledge

Although the field trips to Elkhorn Slough Reserve are generally fact-based, all students are not significantly learning concepts which the Slough values and talks about within its interpretive center. To help the students internalize and retain knowledge about the Slough after a field trip, there are a few things that can be changed. First, teachers may need to go through a longer, more intensive training program. Besides what is currently offered, teachers can be lead through and take turns leading activities and examples of themed field trip ideas. By helping the teachers practice inquiry-based learning, and providing models of teamwork based learning, students could internalize and retain this knowledge (Milton, Cleveland, Bennett-Gates 1995; and Dyasi 2000). Second, the curriculum for Elkhorn Slough needs to be designed in units which provides in-class pre and post field trip ideas and activities. Pre and post field trip assessments can also be developed which the teacher may use as a guide, helping to improve their Elkhorn Slough field trip year after year. Within these new units, it would also be beneficial to outline science standards in which the curriculum applies. This might help teachers

clarify their concepts by using their grade level standards. Third, active monitoring programs can be established at Elkhorn Slough Reserve for students visiting on a field trip. This monitoring data could then be used in the classroom for post field trip lessons. It also gives the students an opportunity to learn about scientific techniques and principles. Often, the more interactive a program is, the more students will remember the experience and facts which are integrated into the monitoring concepts. Finally, given the funds, the Elkhorn Slough Reserve could create a program which provides a skilled and knowledgeable docent who goes into the classroom before the field trip to show slides and talk about what the students might see on their trip. It has been shown that pre field trip programs can help achieve a significant change in knowledge for students (Fortner and Lahm 1990). Another less economical solution would be to host an annual teacher workshop for all teachers trained at Elkhorn Slough Reserve. This would provide a forum for teachers to re-introduce themselves with the Slough and to exchange information and ideas with other teachers. This would also serve as an appropriate place to introduce other environmental education curriculum that the teachers could use in their classroom.

Student Visits

Elkhorn Slough Reserve has never kept track of student return visits. This study provided roughly 440 students with coupons which would have allowed tracking of visits, in addition to an added financial incentive for visiting. No coupons were returned during the three to four month period that the coupons were valid.

Throughout the year, Elkhorn Slough Reserve offers special weekend, themed programs which have attracted four to five hundred visitors within the weekend (Parker 2000). The programs offered on these weekends are not typical of what is usually offered at the Slough. The Reserve may benefit from creating additional programs geared towards families which run on the weekends, attracting more visitors. In addition to programs, Elkhorn Slough Reserve would benefit from increased publicity. Although maps were drawn on the coupons, people may be apprehensive about going to the Slough since it is in a rural, not-frequently-driven area. This research showed that given a financial incentive and a map, there was not enough of a buy-in, either through the parent and/or the child to promote a visit to the Slough.

Limitations

There are a few limitations to this research which should be addressed. This study examined only one grade level, although students in kindergarten through college visit the Reserve. Many types of evaluation exist, although the most commonly used technique was utilized for this research. Although there are many factors that contribute to a change in environmental behavior, only attitude and knowledge were evaluated. Finally, the research was generalized for the group and evaluation was not individualized for each classroom field trip.

Future Research

This research was able to open the doors to further work. First, evaluation across grade levels needs to be examined for students participating in the school programs at Elkhorn Slough Reserve. Qualitative evaluating the students may provide additional insight into the curriculum needs of the students. Also, additional qualitative work with the teachers may also identify their needs, in addition to helping understanding their successes.

Gender differences found in this research provide many questions that need to be answered. Such as, whether these differences persist across grade levels and with various evaluation techniques.

A method of monitoring the visit rate of students across grade levels would be beneficial. An increased monitoring effort across grade levels may allow enough information to be gathered for further analysis on whether information is being transferred from the child to the parent. The parent surveys in this research could be used for this purpose.

Finally, once changes are made to the current Elkhorn Slough Reserve curriculum, it would be important to evaluate the changes in student learning and to provide a path of communication with the teachers regarding these changes.

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APPENDIX A

Tables and Figures

Table 1. Student Summary for Treatment and Control Groups During the Pretest and Posttest Surveys. Numbers are given as frequency/percentage.

		Treatment		Control	
		Pretest	Posttest	Pretest	Posttest
Gender	Female	131/48.0	121/46.2	95/54.0	91/53.8
	Male	142/52.0	141/53.8	81/46.0	78/46.2
First Spoken Language	English	210/77.9	198/75.6	137/77.9	132/78.1
	Spanish	30/11.2	34/13.0	27/15.3	24/14.2
	Other language	20/7.3	25/9.5	8/4.6	11/6.5
	English and Spanish	5/1.8	1/0.4	2/1.1	2/1.2
	English and other language	5/1.8	3/1.1	2/1.1	none
	English, Spanish, other language	none	1/0.4	none	none
Read About Nature (a)	Yes	236/86.4	214/81.7	149/84.7	147/87.0
	No	36/13.2	46/17.6	26/14.8	22/13.0
TV Nature Shows (b)	Yes	235/86.1	229/87.4	158/89.8	150/88.8
	No	37/13.6	32/12.2	18/10.2	19/11.2
Visit an Outdoor Area (c)	5 or more times	131/48.0	114/43.5	83/47.2	84/49.7
	3-4 times	57/20.9	71/27.1	41/23.3	33/19.5
	1-2 times	76/27.8	70/26.7	41/23.3	43/25.4
	Never	6/2.2	7/2.7	10/5.7	8/4.7

(a) Do you sometimes read books or magazines that teach about animals?

(b) Do you sometimes watch nature shows on TV?

(c) How many times in a month do you usually visit an outdoor area (for example: a park, the beach, the mountains)?

Table 2. Attitude Scores for Treatment and Control Groups (a) Descriptive Statistics, (b) ANCOVA ($p = .601$).

(a)

Dependent Variable: Attitude Posttest Mean			
Treatment or Control	Mean	Std. Deviation	N
Control	15.2029	1.5232	8
Treatment	15.2042	1.5267	11
Total	15.2037	1.4823	19

(b)

Dependent Variable: Attitude Posttest Mean						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	26.065 ^a	2	13.032	15.462	.000	.659
Intercept	3.831E-02	1	3.8E-02	.045	.834	.003
Attitude Pretest	26.065	1	26.065	30.925	.000	.659
Control vs. Treatment	.241	1	.241	.285	.601	.018
Error	13.486	16	.843			
Total	4431.419	19				
Corrected Total	39.550	18				

^a. R Squared = .659 (Adjusted R Squared = .616)

Table 3. Knowledge Scores for Treatment and Control Groups (a) Descriptive Statistics, (b) ANCOVA ($p = .044$).

(a)

Dependent Variable: Knowledge Posttest Mean			
Treatment or Control	Mean	Std. Deviation	N
Control	16.4270	1.2235	8
Treatment	17.6322	1.9698	11
Total	17.1247	1.7640	19

(b)

Dependent Variable: Knowledge Posttest Mean						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	36.761 ^a	2	18.381	15.280	.000	.656
Intercept	15.220	1	15.220	12.652	.003	.442
Knowledge Pretest	30.034	1	30.034	24.968	.000	.609
Control vs. Treatment	5.767	1	5.767	4.794	.044	.231
Error	19.247	16	1.203			
Total	5627.877	19				
Corrected Total	56.008	18				

^a. R Squared = .656 (Adjusted R Squared = .613)

Table 4. Knowledge Scores Without Question #18 for Treatment and Control Groups (a) Descriptive Statistics, (b) ANCOVA ($p = .115$).

(a)

Dependent Variable: Posttest knowledge sum without 18

Treatment or Control	Mean	Std. Deviation	N
Control	16.0484	1.2112	8
Treatment	16.9812	1.9199	11
Total	16.5884	1.6859	19

(b)

Dependent Variable: Posttest knowledge sum without 18

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	31.982 ^a	2	15.991	13.341	.000	.625
Intercept	16.294	1	16.294	13.594	.002	.459
Knowledge Pretest without #18	27.951	1	27.951	23.319	.000	.593
Control vs. Treatment	3.324	1	3.324	2.773	.115	.148
Error	19.179	16	1.199			
Total	5279.511	19				
Corrected Total	51.160	18				

^a. R Squared = .625 (Adjusted R Squared = .578)

Table 5. Knowledge Scores for Girls in the Treatment and Control groups (a) Descriptive Statistics, (b) ANCOVA ($p = .009$).

(a)

Dependent Variable: Knowledge Posttest Girls			
Treatment vs. Control	Mean	Std. Deviation	N
Control	16.1796	1.0080	8
Treatment	17.9263	1.9499	11
Total	17.1908	1.8145	19

(b)

Dependent Variable: Knowledge Posttest Girls						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	40.399 ^a	2	20.199	17.131	.000	.682
Intercept	27.960	1	27.960	23.713	.000	.597
Knowledge Pretest Girls	26.269	1	26.269	22.278	.000	.582
Treatment vs. Control	10.347	1	10.347	8.775	.009	.354
Error	18.866	16	1.179			
Total	5674.224	19				
Corrected Total	59.265	18				

^a. R Squared = .682 (Adjusted R Squared = .642)

Table 6. Knowledge Scores Without Question #18 for Girls in the Treatment and Control groups (a) Descriptive Statistics, (b) ANCOVA (p = .040).

(a)

Dependent Variable: KW18GLPS			
Treatment or Control	Mean	Std. Deviation	N
Control	15.7938	.9205	8
Treatment	17.2357	1.9029	11
Total	16.6286	1.6959	19

(b)

Dependent Variable: KW18GLPS						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	31.011 ^a	2	15.506	11.952	.001	.599
Intercept	30.643	1	30.643	23.620	.000	.596
KW18GLPR	21.383	1	21.383	16.482	.001	.507
TYPE	6.460	1	6.460	4.979	.040	.237
Error	20.758	16	1.297			
Total	5305.450	19				
Corrected Total	51.769	18				

^a. R Squared = .599 (Adjusted R Squared = .549)

Table 7. Knowledge Scores Without Question #18 for Boys in the Treatment and Control groups (a) Descriptive Statistics, (b) ANCOVA ($p = .807$).

(a)

Dependent Variable: KW18BYPS			
Treatment or Control	Mean	Std. Deviation	N
Control	16.5090	2.0587	8
Treatment	16.5428	2.3345	11
Total	16.5285	2.1624	19

(b)

Dependent Variable: KW18BYPS						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	41.370 ^a	2	20.685	7.733	.004	.492
Intercept	25.312	1	25.312	9.462	.007	.372
KW18BYPR	41.365	1	41.365	15.463	.001	.491
TYPE	.165	1	.165	.062	.807	.004
Error	42.801	16	2.675			
Total	5274.835	19				
Corrected Total	84.171	18				

^a. R Squared = .492 (Adjusted R Squared = .428)

Table 8. School's Distance from Elkhorn Slough Reserve

	<u>10-25 Miles</u>	<u>40-50 Miles</u>	<u>>75 Miles</u>
School 1	X		
School 2	X		
School 3	X		
School 4		X	
School 5		X	
School 6			X
School 7			X
School 8			X

Figure 1. Attitude Pretest and Posttest Means Between Treatment and Control Groups.

Figure 2. Boxplot for Treatment and Control Attitude Scores on the Pretest and Posttest Surveys.

The top of the box represents the 25th percentile and the bottom of the box represents the 75th percentile. The solid line within the box represents the median score (50th percentile) for each group. The top and bottom whiskers represent the largest and smallest values that fall within 1.5 box lengths. The circles represent the outliers that fall between 1.5 and 3 box lengths.

Figure 3. Knowledge Pretest/Posttest Means for Treatment and Control Groups.

Figure 4. Boxplot for Treatment and Control Knowledge Scores on the Pretest and Posttest Surveys.

The top of the box represents the 25th percentile and the bottom of the box represents the 75th percentile. The solid line within the box represents the median score (50th percentile) for each group. The top and bottom whiskers represent the largest and smallest values that fall within 1.5 box lengths. The circles represent the outliers that fall between 1.5 and 3 box lengths.

Figure 5. Attitude Averages for CONTROL Groups by Gender.

Figure 6. Attitude Averages for TREATMENT Groups by Gender.

Figure 7. Boxplot of Attitude Scores for BOYS. **Figure 8. Boxplot of Attitude Scores for GIRLS.**

The 25th (box top), 50th (median), and 75th (box bottom) percentiles are represented. Whiskers represent high and low scores within 1.5 box lengths, while outliers represent scores that fall between 1.5 and 3 box lengths.

Figure 9. Knowledge Averages for CONTROL Groups by Gender.

Figure 10. Knowledge Averages for TREATMENT Groups by Gender.

Figure 11. Boxplot in Knowledge Scores for BOYS. **Figure 12. Boxplot in Knowledge Scores for GIRLS.**

The 25th (box top), 50th (median), and 75th (box bottom) percentiles are represented. Whiskers represent high and low scores within 1.5 box lengths, while outliers represent scores that fall between 1.5 and 3 box lengths.

APPENDIX B

Letter to Treatment Teachers and Teacher Questionnaire

ELKHORN SLOUGH NATIONAL ESTUARINE RESEARCH RESERVE
1700 Elkhorn Road • Watsonville, CA 95076 • (408) 728-2822

March 10, 2000

Dear

My name is Kim Shirley and I am a Master's student in the Environmental Studies Department at San Jose State University. I am conducting environmental education research through the Elkhorn Slough National Estuarine Research Reserve. Specifically, I am looking at the effects of Elkhorn Slough Reserve field trips on environmental attitudes and knowledge in fourth graders. Due to your upcoming scheduled field trip, your class has been identified as a candidate for participation in my research.

My research will consist of a pre- and post-visit survey, which will be administered in the classroom two weeks prior and two weeks after the student's field trip to Elkhorn Slough. I will administer the survey myself and only ask that I have 30 minutes of classroom time with your students for each visit. All information gathered from these surveys will be analyzed and used to help evaluate the Elkhorn Slough Reserve educational programs, as well as provide information for use in development of new Elkhorn Slough curricula. Your name, the names of the students, and the school name will be kept confidential. Class summary totals will be available to you upon request after the study is completed.

For the information gathered to be most useful, I need to have numerous fourth grade classes participate. Your cooperation is vital to this research. Participation comes with several benefits. It provides the students with the experience of participating and learning about scientific research. I will answer any class questions about the research, or any environmental questions following the post-visit survey, thus providing a learning experience for the students. In addition, all students who participate will be receiving a coupon for a FREE family admission to the Elkhorn Slough Reserve to encourage a return trip with their family. These coupons not only benefit the students, but they will also provide valuable information regarding the student's return visit rate (also a part of my study). Participating classrooms will also receive the Monterey Bay Aquarium's book about Elkhorn Slough, along with an Elkhorn Slough Reserve poster.

I sincerely appreciate your consideration of my request. Please fill out and return the enclosed questionnaire in the envelope provided, and I will contact you to arrange survey administration dates. Feel free to contact me with any questions you might have regarding the research or my educational/career background.

Once again, thank you for your consideration in helping me conduct this research. Your participation is greatly appreciated.

Sincerely,

Kim Shirley

The Elkhorn Slough Estuarine Research Reserve is managed by the California Department of Fish and Game in cooperation with the National Oceanic and Atmospheric Administration

Elkhorn Slough Teacher Questionnaire

The following questionnaire will be used to help interpret data received in this study. Please take a few minutes to completely fill out each question. I will contact you upon receiving this questionnaire. A self-addressed stamped envelope has been included for your convenience. All information is confidential and your questionnaire will be identified only through a teacher and school identification number which has been assigned to you.

This questionnaire is voluntary. You may decline to participate or you may withdraw from this study at any time without prejudice from San Jose State University, Elkhorn Slough Reserve, or any other participating agency. If you have any questions regarding this research, I will be happy to talk with you. I can be reached at (831) 649-3833. Complaints about the research may be presented to Dr. Les Rowntree, Department Chair of Environmental Studies at (408) 924-5450. Questions about research, subjects' rights, or research-related injury may be presented to Nabil Ibrahim, Ph.D., Associate Vice President for Graduate Studies and Research, at (408) 924-2480.

1. Teacher's LD. # _____
2. School LD.# _____ Grade _____ # of Students in Class _____
3. Contact Information:

School Phone _____ Best time to be reached _____

School _____

Address _____ City _____ Zip _____

Email _____
4. Elkhorn Slough Field Trip Date _____
5. What areas will your class focus on during its field trip?
6. What is your plan for the day at Elkhorn Slough Reserve?

7. Please describe what type of pre-field trip lessons are taught (if any) prior to the student's visit.

8. Please describe any post-field trip lessons (if any) in the classroom.

9. What other field trips does your class participate in throughout the school year?

Thank you for your time! Please send the completed questionnaire in the enclosed envelope. After survey times are scheduled, I will send out parental consent forms for all students. Permission from parents/guardians is necessary for student participation in the research as required by San Jose State University. For questions or additional information, please contact me:

Kim Shirley.
kshirley@email.sjsu.edu
Home- 831/649-3833
215 5th St. Pacific Grove, CA 93950
Work (Elkhorn School)- 831/633-2405

APPENDIX C

Letter to Control Teachers and Teacher Questionnaire

ELKHORN SLOUGH NATIONAL ESTUARINE RESEARCH RESERVE
 1700 Elkhorn Road • Watsonville, CA 95076 • (408) 728-2822

March 21, 2000

Dear

My name is Kim Shirley and I am a Master's student in the Environmental Studies Department at San Jose State University. I am conducting environmental education research through the Elkhorn Slough National Estuarine Research Reserve in Watsonville. Specifically, I am looking at the effects of Elkhorn Slough Reserve field trips on environmental attitudes and knowledge in fourth graders. Your class has been identified as a candidate for participation in this research.

The design of this research consists of treatment groups (those who schedule a field trip) and for comparison, control groups (those who don't go on an Elkhorn Slough Reserve field trip). Your class has been selected to participate in the "control" group for this research. All classes participating in the research will be administered a pre- and post field trip survey. Control classrooms will have approximately one month between each survey. I will administer the survey myself and only ask that I have 30 minutes of classroom time with your students for each visit.

All information gathered from these surveys will be analyzed and used to help evaluate the Elkhorn Slough Reserve educational programs, as well as provide information for use in development of new Elkhorn Slough curricula. Your name, the names of the students, and the school name will be kept confidential. Class summary totals will be available to you upon request after the study is completed.

For the information gathered to be most useful, I need to have numerous fourth grade classes participate. Your cooperation is vital to this research. Participation comes with several benefits. I am offering a scholarship for the teacher training course at Elkhorn Slough Reserve. This study also provides the students with the experience of participating and learning about research. I will answer any class questions about the research, or any environmental questions following the post-visit survey, thus providing a learning experience for the students. In addition, all students who participate will be receiving a coupon for a FREE family admission to the Elkhorn Slough Reserve to encourage a trip with their family. These coupons not only benefit the students, but they will also provide valuable information regarding the student's visit rate (also a part of my study). Participating classrooms will also receive the Monterey Bay Aquarium's book about Elkhorn Slough, along with an Elkhorn Slough Reserve poster.

I sincerely appreciate your consideration of my request. Please fill out and return the enclosed questionnaire in the envelope provided, and I will contact you to arrange survey administration dates. Feel free to contact me with any questions you might have regarding the research or my educational/career background.

Once again, thank you for your consideration in helping me conduct this research. Your participation is greatly appreciated.

Sincerely,

Kim Shirley

The Elkhorn Slough Estuarine Research Reserve is managed by the California Department of Fish and Game in cooperation with the National Oceanic and Atmospheric Administration

Elkhorn Slough Teacher Questionnaire

The following questionnaire will be used to help interpret data received in this study. Please take a few minutes to completely fill out each question. I will contact you upon receiving this questionnaire. A self-addressed stamped envelope has been included for your convenience. All information is confidential and your questionnaire will be identified only through a teacher and school identification number which has been assigned to you.

This questionnaire is voluntary. You may decline to participate or you may withdraw from this study at any time without prejudice from San Jose State University, Elkhorn Slough Reserve, or any other participating agency. If you have any questions regarding this research, I will be happy to talk with you. I can be reached at (831) 649-3833. Complaints about the research may be presented to Dr. Les Rowntree, Department Chair of Environmental Studies at (408) 924-5450. Questions about research, subjects' rights, or research-related injury may be presented to Nabil Ibrahim, Ph.D., Associate Vice President for Graduate Studies and Research, at (408) 924-2480.

1. Teacher's I.D. # _____
2. School I.D.# _____ Grade _____ # of Students in Class _____
3. Contact Information:
 - School Phone _____ Best time to be reached _____
 - School Address _____ City _____ Zip _____
 - Email _____
4. The following pre- and post-visit date/times have been scheduled with the "treatment" class(es) at your school. I will be visiting your class during this time, as well. Please indicate if you would like to schedule a different time for the pre- and post-visit survey.
5. Approximately how much classroom time per week is spent talking about environmental/science issues?

6. What are the main topics of science learning in your classroom?
7. Do you take your classes on field trips? If yes, which ones do you typically visit in a school year?
8. If yes to above, what topics are focused on for each field trip?
9. Would you like to learn more about field trips to Elkhorn Slough Reserve?

Thank you for your time! Please send the completed questionnaire in the enclosed envelope. After survey times are scheduled, I will send out parental consent forms for all students. Permission from parents/guardians is necessary for student participation in the research as required by San Jose State University. For questions or additional information, please contact me:

Kim Shirley
kshirley@email.sjsu.edu
Home- 831/649-3833
215 5th St. Pacific Grove, CA 93950
Work (Elkhorn School)- 831/633-2405

APPENDIX D

Permission Letter to Parents: English, Spanish, and Human Subjects Letter

**San José State
UNIVERSITY**

Department of
Environmental Studies
One Washington Square
San José, CA 95192-0115
Voice: 408-924-5450
Fax: 408-924-5477

Dear Parents,

March 27, 2000

My name is Kim Shirley. I am a Master's student in the Environmental Studies Department at San Jose State University. I am conducting research regarding the effects of the educational program offered at the Elkhorn Slough National Estuarine Research Reserve. Your child's class has been selected to participate in this research. Students will fill out a true/false and multiple choice survey about environmental attitudes and knowledge. All information gathered will be used to help evaluate the Elkhorn Slough Reserve educational programs, as well as develop new ones.

Parental permission for participation is required for all students. There are no risks to your child in participating. Their name will not be included on the survey. The results of the study may be published, but no information that could identify individual students will be included.

If you decide that your child should not participate in this research, it will have no effect on his/her grade in the classroom. Although, participation does come with many benefits! It provides the students with the experience of learning about research as well as learning about the environment. In addition, all students who participate will be receiving a coupon at the end of the testing which will allow a return trip to Elkhorn Slough with their family for FREE.

If you have any questions regarding this research, I will be happy to talk with you. I can be reached at (831) 649-3833. Complaints about the research may be presented to Dr. Les Rowntree, Department Chair of Environmental Studies at (408) 924-5450. Questions about research, subjects' rights, or research-related injury may be presented to Nabil Ibrahim, Ph.D., Associate Vice President for Graduate Studies and Research, at (408) 924-2480.

This consent is voluntary and your child may refuse to participate in the study or any part of the study. If so, it will not affect your relations with your child's school or with the Elkhorn Slough Reserve. I do appreciate your consideration for allowing your child to participate in this important research.

Sincerely,

Kim Shirley

The signature of a parent or guardian on this document indicates approval for the child or ward to participate in the study and a statement that the child or ward is freely willing to participate.

_____ Name of Child or Ward	_____ Parent or Guardian's Signature	_____ Date
_____ Relation of Child or Ward	_____ Phone	
_____ Full Mailing Address		
_____ Investigator's Signature		_____ Date

Five California State University:
Chancellor's Office
Bakersfield, Chico, Dominguez Hills,
Fresno, Fullerton, Hayward, Humboldt,
Long Beach, Los Angeles, Maritime Academy,
Maritime West Northridge, Pomona,
Sacramento, San Bernardino, San Diego,
San Francisco, San José, San Luis Obispo,
San Marcos, Sonoma, Stanislaus

San José State
UNIVERSITY

Department of
Environmental Studies
One Washington Square
San José, CA 95122-0115
Voice: 408-924-5450
Fax: 408-924-5477

Estimados padres,

27 Marzo 2000

Mi nombre es Kim Shirley. Soy estudiante de un año en el Departamento Ambiental de los Estudios en la universidad de estado del San José. Estoy conduciendo la investigación con respecto a los efectos del programa educativo ofrecido en la Reserva de Estuario Nacional de la investigación de Elkhorn Slough. La clase de su hijo/a se ha seleccionado participar en esta investigación. Los estudiantes completarán una encuesta (verdadero o falso) bien escogida sobre múltiples actitudes ambientales y conocimiento. Toda la información recopilada será utilizada para ayudar a evaluar los programas educativos de la reserva de Elkhorn Slough, así como desarrolla nuevos.

El permiso parental para la participación se requiere para todos los estudiantes. No hay riesgos a su niño en participar. Su nombre no será incluido en la encuesta. Los resultados del estudio pueden ser publicados, pero no hay información que podría identificar a estudiantes individuales incluida.

Si usted decide que su niño no debe participar en este encuesta, no tendrá ningún efecto en su grado en la clase. Aunque, la participación viene con muchas ventajas! Provee de los estudiantes la experiencia de aprender sobre la investigación así como aprender sobre el ambiente. Además, todos los estudiantes que participan recibirán una cupón en el final de la prueba que permitirá un viaje de vuelta a Elkhorn Slough con su familia para GRATIS.

Si usted tiene cualesquiera preguntas con respecto a este encuesta, me placere hablar con usted. Puedo ser alcanzado en (831) 649-3833. Quejas sobre el encuesta se pueden presentar al Dr. Les Rowntree, silla del departamento de estudios ambientales en (408) 924-5450. Preguntas sobre la investigación, las derechos sujetas, o lesión investigación-relacionada se puede presentar a Nabil Ibrahim, Ph.D., vice presidente del asociado los estudios del graduado y la investigación, a (408) 924-2480.

Este consentimiento es voluntario y su hijo/a puede rechazar participar en el estudio o cualquier parte del estudio. Si es así no afectará sus relaciones con la escuela de su niño o con la reserva de Elkhorn Slough. Aprecio su consideración para permitir que su niño participe en esta investigación importante.

Sinceramente,

Kim Shirley

La firma de un padre o de un guarda en este documento indica la aprobación para el niño para participar en el estudio y una declaración que el niño o la sala está queriendo libremente participar.

Nombre del hijo/a _____ Firma del padre o del guarda _____ Fecha _____

Nombre de la relación del hijo/a _____ Numero del teléfono _____

Dirección completo _____

Firma del investigador _____ Fecha _____

The California State University:
Chancellor's Office
Bakersfield, Chico, Dominguez Hills,
Fresno, Fullerton, Hayward, Humboldt,
Long Beach, Los Angeles, Maritime Academy,
Monterey Bay, Northridge, Pomona,
Sacramento, San Bernardino, San Diego,
San Francisco, San José, San Luis Obispo,
San Marcos, Sonoma, Stanislaus

**San José State -
UNIVERSITY**

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San José, CA 95192-0025
Voice: 408-924-2480
Fax: 408-924-2477
E-mail: gstudies@wsn.sjsu.edu
<http://www.sjsu.edu>

TO: Kim Shirley
215 5th St.
Pacific Grove, CA 93950

FROM: Craig Cisar,
Chairperson, Human Subjects Review Board

DATE: March 13, 2000

The Human Subjects-Institutional Review Board has approved
your request to use human subjects in the study entitled:

"Evaluation of Elkhorn Slough Environmental
Programs: Do they make a Difference?"

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to any and all data that may be collected from the subjects. The Board's approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Nabil Ibrahim, Ph.D., immediately. Injury includes but is not limited to bodily harm, psychological trauma and release of potentially damaging personal information.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at
(408) 924-2480.

The California State University:
Chancellor's Office
Bakersfield, Chico, Dominguez Hills,
Fresno, Fullerton, Hayward, Humboldt,
Long Beach, Los Angeles, Maritime Academy,
Monterey Bay, Northridge, Pomona,
Sacramento, San Bernardino, San Diego,
San Francisco, San José, San Luis Obispo,
San Marcos, Sonoma, Stanislaus

APPENDIX E

Student Coupon

APPENDIX F

Parent Surveys: Control and Treatment

Elkhorn Slough Reserve Parent Survey

1. What is your reason for visiting Elkhorn Slough Reserve?
2. Did you know about Elkhorn Slough Reserve before your child participated in this survey?
3. Would you have come to Elkhorn Slough Reserve even if you didn't have a coupon?
4. Have you and/or your family been here before? If so, what do you remember most?
5. Do you discuss environmental topics with your children? If so, what topics are most important to you and your children?
6. How often does your family visit outdoor areas (for example, nature areas such as Elkhorn Slough, the beaches, mountains, or parks)?

**Elkhorn Slough Reserve
Parent Survey**

1. What is your reason for visiting Elkhorn Slough Reserve?
2. Would you have come to Elkhorn Slough Reserve even if you didn't have a coupon?
3. Have you and/or your family been here before? If so, what do you remember most?
4. Did you chaperone your child's field trip to Elkhorn Slough? If so, did you enjoy the field trip? What new things did you learn?
5. Did your child talk to you about their experience at Elkhorn Slough? If so, what did they talk to you about?
6. What facts or knowledge did they share?

7. Did they enjoy their field trip?

8. Were they excited about what they had learned about the environment?
If so, what were they excited about?

9. How often does your family visit outdoor areas (for example, nature areas such as Elkhorn Slough, the beaches, mountains, or parks)?

APPENDIX G

Student Survey: Pilot and Final

Elkhorn Slough 4th Grade Survey

107

Welcome to the Elkhorn Slough environmental survey! Your feelings and thoughts are important.

Please clearly circle all of your answers.

1. Are you a:
Girl Boy
 2. What was your first spoken language?
English Spanish Other
 3. Do you read books or magazines that teach about animals?
YES NO
 4. Do you watch nature shows on TV?
YES NO
 5. How many times in a month do you usually visit an outdoor area (for example: park, beach, mountains)?
A) 5 or more.
B) 3-4
C) 1-2
D) Never.
-

Please circle YES or NO to the following statements:

1. I would NOT give \$10 of my own money to help the environment.
YES NO
2. I would NOT be willing to separate my family's trash for recycling.
YES NO
3. To save water, I would be willing to turn off the water while I wash my hands.
YES NO
4. I would be willing to ask people to help reduce pollution.
YES NO
5. I would like to help plant trees and flowers in a nature area.
YES NO
6. I have talked with my parents about how to help with environmental problems.
YES NO

7. To save energy, I turn off lights at home when I don't need them.
YES NO
8. I have asked my family to recycle some of the things we use.
YES NO
9. I do NOT let a water faucet run when it is not necessary.
YES NO
10. I do NOT separate things at home for recycling.
YES NO
11. I like to learn about nature.
YES NO
12. I am frightened to think people don't care about the environment.
YES NO
13. I get angry about the damage pollution does to the environment.
YES NO
14. It makes me happy when people recycle used bottles, cans, and paper.
YES NO
15. It makes me happy to see people trying to save energy.
YES NO
16. I am NOT worried about running out of water in my city.
YES NO
17. I do NOT worry about environmental problems.
YES NO
18. I am NOT frightened about the effects of pollution on my family.
YES NO
19. I get upset when I think of the things people throw away that could be recycled.
YES NO
20. It upsets me when I see people use too much water.
YES NO
21. I do NOT worry about wetlands being changed by people building on them.
YES NO
22. I get worried about the chemicals that may be going into the ocean.
YES NO

23. I worry because there are very few wetland areas left in the State.

YES NO

24. I feel that people in government know a lot about protecting our environment.

YES NO

25. I do NOT like to go out into nature areas because of things that can hurt me.

YES NO

The following questions are multiple choice. Please circle the correct answer.

1. Where does most of the garbage go after it is dumped from the garbage trucks?

- A) It is dumped into the ocean.
- B) It is recycled to make plastic.
- C) To a landfill where it is buried.
- D) To farmers for use as fertilizer.

2. Environmental problems are a threat to:

- A) only people who live in cities.
- B) only wild animals and endangered species.
- C) mostly tropical plants and animals.
- D) all living things in the world.

3. The main problem with landfills is that they:

- A) take up too much space.
- B) are ugly to look at and smell bad.
- C) attract rats and other pests.
- D) prevent farming of nearby land.

4. Where is water under the ground found?

- A) in landfills.
- B) in ponds.
- C) in aquifers.
- D) in rivers.

5. An example of a nonrenewable resource is:

- A) gas.
- B) trees.
- C) sunlight.
- D) animals raised for food.

6. An item which can not be recycled and used again is:
A) disposable diapers.
B) newspapers.
C) motor oil.
D) plastic bottles.
7. A species that no longer exists is:
A) protected.
B) endangered.
C) abundant.
D) extinct.
8. What is the beginning (bottom) of the marine food web?
A) Plant plankton
B) Fish
C) Crabs
D) Sea snails
9. Why is a wetland an important place?
A) It catches water for people to drink.
B) It filters water and provides a place for baby fish, sharks, and birds to be born.
C) It cools the air.
D) It protects us from large waves from the ocean.
10. Non-native plants:
A) Give us food to eat.
B) Leave little space for native plants to grow.
C) Are good because they grow well at Elkhorn Slough.
D) Provide good habitat for native animals.
11. Elkhorn Slough needs to be protected because:
A) It provides habitat for many plants and animals.
B) It filters pollutants from water run-off from the land.
C) It provides a place for migrating birds to rest.
D) All of the above.
12. Researchers are monitoring the Slough. Why?
A) To better understand the health of the Slough.
B) College students need research projects.
C) To make sure no one dumps trash in the Slough.
D) It is a nice place to work.
13. Tides come in and out of Elkhorn Slough:
A) Two times a day.
B) One time a day.
C) Never.
D) Three times a day.

14. What does biodiversity mean?

- A) There are a lot of plants in an area.
- B) Plants and animals that are alive.
- D) Many types of plants and animals in an area.
- C) There are a lot of birds in an area.

15. Elkhorn Slough has different habitats. What are they?

- A) Mud flats, Uplands, Saltmarsh
- B) Tropical forests, Sandy beach, Coral reefs
- C) Redwood forest, Mud flats, Desert
- D) Desert, Grassland, Sandy beach

16. What does conservation mean?

- A) To protect the land, animals, plants, and water from ALL uses.
- B) To use our resources wisely.
- C) To prevent land from being built upon.
- D) None of the above.

17. What does the word "watershed" mean?

- A) It is a place that holds water.
- B) It is a land area where water drains to the ocean or rivers.
- C) It is another name for a roof that protects people from the rain.
- D) It is a type of boat.

18. What is a wetland?

- A) An area that contains water all year long.
- B) After it rains, the land is called this.
- C) It is a place that contains water during the rainy season.
- D) It is another name for a lake.

19. Natural areas are protected:

- A) To keep people from damaging the land.
- B) So that people can use the land to learn about plants and animals.
- C) So that plants and animals will have a home.
- D) All of the above.

20. Do the things you do at home effect the ocean?

- A) No, I live too far from the ocean.
- B) Yes, I live close to the ocean.
- C) Yes, pollution can drain into the street.
- D) No, my house is surrounded by other houses.

21. Storm drains take water from the streets and:

- A) Drains it to the ocean.
- B) Drains it underground.
- C) Takes it to a sewage plant.
- D) Takes it to a lake.

22. What animals can live in a mudflat?
- A) Worms
 - B) Crabs
 - C) Clams
 - D) All of the above
23. Which of these statements is TRUE about a saltmarsh?
- A) It is too salty for plants.
 - B) It is too salty for animals.
 - C) Only a few types of plants can live in the salty soil.
 - D) All of the above.
24. What was Elkhorn Slough used for before it became a nature preserve?
- A) Dairy
 - B) Rice farm
 - C) Airport
 - D) Golf Course
25. Which of these statements is TRUE about mudflats?
- A) They are never covered by water.
 - B) They are home to many animals.
 - C) They provide a feeding ground for gray whales.
 - D) There is no oxygen and animals can not live there.
26. The land which surrounds Elkhorn Slough has many uses. What are some of these uses?
- A) Agriculture, dairies.
 - B) Junk yard.
 - C) Power plant.
 - D) All of the above.

Draw a line from the plant or animal to its habitat (where it lives).

Plant or Animal

Habitats

Clam

Fat innkeeper worm

Plankton

Salt Grass

Mouse

Pickleweed

Salt Marsh

Uplands

Mudflats

Always Underwater

Elkhorn Slough 4th Grade Survey

Welcome to the Elkhorn Slough environmental survey! Thank you for answering our questions.

Please clearly circle all of your answers.

1. Are you a:
 Girl Boy
2. What was your first spoken language?
 English Spanish Other language
3. Do you sometimes read books or magazines that teach about animals?
 YES NO
4. Do you sometimes watch nature shows on TV?
 YES NO
5. How many times in a month do you usually visit an outdoor area (for example: a park, the beach, the mountains)?
 A) 5 or more.
 B) 3-4
 C) 1-2
 D) Never.

The following questions will be answered either TRUE or FALSE.
 Here are some practice items:

1. I like to do fun things.
 TRUE FALSE
2. I like to be sick.
 TRUE FALSE
3. I get upset when bad things happen to me.
 TRUE FALSE
4. I do not like to take vacations from school.
 TRUE FALSE

1. I would NOT be willing to separate my family's trash for recycling.
TRUE FALSE
2. I would like to help plant trees and flowers in a nature area.
TRUE FALSE
3. I have talked with my parents about how to help with environmental problems.
TRUE FALSE
4. To save energy, I turn off lights at home when I don't need them.
TRUE FALSE
5. I have asked my family to recycle some of the things we use.
TRUE FALSE
6. I do NOT let a water faucet run when it is not necessary.
TRUE FALSE
7. I do NOT separate things at home for recycling.
TRUE FALSE
8. I like to learn about nature.
TRUE FALSE
9. I am frightened to think people don't care about the environment.
TRUE FALSE
10. I get angry about the damage pollution does to the environment.
TRUE FALSE
11. It makes me happy when people recycle used bottles, cans, and paper.
TRUE FALSE
12. It makes me happy to see people trying to save energy.
TRUE FALSE
13. I am NOT worried about running out of water in my town.
TRUE FALSE
14. I get upset when I think of the things people throw away that could be recycled.
TRUE FALSE
15. It upsets me when I see people use too much water.
TRUE FALSE
16. I do NOT worry about wetlands being changed by people building on them.
TRUE FALSE

17. I get worried about farm run-off that may be going into the ocean.
TRUE FALSE
18. I worry because there are very few wetland areas left in California.
TRUE FALSE
19. I feel that people in government know a lot about protecting our environment.
TRUE FALSE
20. I do NOT like to go out into nature areas because of animals that can hurt me.
TRUE FALSE

The following questions are multiple choice. Please circle the LETTER of the best answer. Choose only one answer for each question.

1. Where does most of the garbage go after it is dumped from the garbage trucks?
A) It is dumped into the ocean.
B) It is recycled to make plastic.
C) To a landfill where it is buried.
D) To farmers for use as fertilizer.
2. Environmental problems are a threat to:
A) only people who live in cities.
B) only wild animals and endangered species.
C) mostly tropical plants and animals.
D) all living things in the world.
3. Where is water under the ground found?
A) in landfills.
B) in ponds.
C) in aquifers.
D) in rivers.
4. An item which can not be recycled and used again is:
A) disposable diapers.
B) newspapers.
C) motor oil.
D) plastic bottles.

5. What is the beginning (bottom) of the marine food web?
 - A) Crabs
 - B) Fish
 - C) Plant plankton
 - D) Sea snails
6. Why is a wetland an important place?
 - A) It catches water for people to drink.
 - B) It filters water and provides a place for baby fish and birds to be born.
 - C) It cools the air.
 - D) It protects us from large waves from the ocean.
7. Non-native plants:
 - A) Give us food to eat.
 - B) Leave little space for native plants to grow.
 - C) Are good because they grow well at Elkhorn Slough.
 - D) Provide good habitat for native animals.
8. Elkhorn Slough needs to be protected because:
 - A) It provides habitat for many plants and animals.
 - B) It filters pollutants from water run-off from the land.
 - C) It provides a place for migrating birds to rest.
 - D) All of the above.
9. People are monitoring the Slough. Why?
 - A) To better understand the health of the Slough.
 - B) College students need research projects.
 - C) To make sure no one dumps trash in the Slough.
 - D) It is a nice place to work.
10. Tides come in and out of Elkhorn Slough:
 - A) Two times a day.
 - B) One time a day.
 - C) Never.
 - D) Three times a day.
11. What does biodiversity mean?
 - A) There are a lot of plants in an area.
 - B) Plants and animals that are alive.
 - C) Many types of plants and animals in an area.
 - D) There are a lot of birds in an area.
12. Elkhorn Slough has different habitats. What are they?
 - A) Mud flats, Uplands, Saltmarsh
 - B) Tropical forests, Sandy beach, Coral reefs
 - C) Redwood forest, Mud flats, Desert
 - D) Desert, Grassland, Sandy beach

13. What does the word "watershed" mean?
- A) It is a place that holds water.
 - B) It is a land area where water drains to the ocean or rivers.
 - C) It is another name for a roof that protects people from the rain.
 - D) It is a type of boat.
14. Natural areas are protected:
- A) To keep people from damaging the land.
 - B) So that people can use the land to learn about plants and animals.
 - C) So that plants and animals will have a home.
 - D) All of the above.
15. Do the things you do at home effect the ocean?
- A) No, I live too far from the ocean.
 - B) Yes, I live close to the ocean.
 - C) Yes, pollution can drain into the streets and out to the ocean.
 - D) No, my house is surrounded by other houses.
16. What animals can live in a mudflat?
- A) Sea star
 - B) Clams
 - C) Hermit crabs
 - D) All of the above
17. Which of these statements is TRUE about a saltmarsh?
- A) It is too salty for plants.
 - B) It is too salty for animals.
 - C) Only a few types of plants can live in the salty soil.
 - D) All of the above.
18. What was Elkhorn Slough used for before it became a nature preserve?
- A) Dairy
 - B) Rice farm
 - C) Airport
 - D) Golf Course
19. Which of these statements is TRUE about mudflats?
- A) They are never covered by water.
 - B) They are home to many animals.
 - C) They provide a feeding ground for gray whales.
 - D) There is no oxygen and animals can not live there.
20. The land which surrounds Elkhorn Slough has many uses. What are some of these uses?
- A) Agriculture, dairies.
 - B) Junk yard.
 - C) Power plant.
 - D) All of the above

Below are four habitats where different plants and animals live.

A) Salt Marsh

C) Uplands

B) Mudflats

D) Always In The Water

Tell us where these animals or plants live. Place the letter of the correct habitat next to the animal or plant.

Jelly Fish _____

Snake _____

Mouse _____

Moon Snail _____

Plankton _____

Salt Grass _____

Pickleweed _____

Poison Oak _____

Fat innkeeper worm _____

Shark _____

APPENDIX H

Student Survey Questions and Answers

Attitude Questions

Question #1: "I am NOT willing to separate my family's trash for recycling."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I am NOT willing to separate my family's trash for recycling	False	Count	45	45	90
				50.0%	50.0%	100.0%
		True	Count	124	131	255
				48.6%	51.4%	100.0%
	Total			Count	169	176
					49.0%	51.0%
Treatment	I am NOT willing to separate my family's trash for recycling	False	Count	73	98	171
				42.7%	57.3%	100.0%
		True	Count	188	175	363
				51.8%	48.2%	100.0%
	Total			Count	261	273
					48.9%	51.1%

Question #2: "I would like to plant trees and flowers in a nature area."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I would like to plant trees and flowers in a nature area	False	Count	17	9	26
				65.4%	34.6%	100.0%
		True	Count	152	167	319
				47.6%	52.4%	100.0%
	Total			Count	169	176
					49.0%	51.0%
Treatment	I would like to plant trees and flowers in a nature area	False	Count	29	21	50
				58.0%	42.0%	100.0%
		True	Count	233	251	484
				48.1%	51.9%	100.0%
	Total			Count	262	272
					49.1%	50.9%

Question #3: "I have talked with my parents about how to help with environmental problems."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I have talked with my parents about how to help with environmental problems	False	Count	98	90	188
				52.1%	47.9%	100.0%
		True	Count	71	84	155
				45.8%	54.2%	100.0%
	Total			Count	169	174
					49.3%	50.7%
Treatment	I have talked with my parents about how to help with environmental problems	False	Count	136	127	263
				51.7%	48.3%	100.0%
		True	Count	126	143	269
				46.8%	53.2%	100.0%
	Total			Count	262	270
					49.2%	50.8%

Question #4: "To save energy, I turn off lights at home when I don't need them."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	To save energy, I turn off lights at home when I don't need them	False	Count	23	23	46
				50.0%	50.0%	100.0%
		True	Count	144	152	296
				48.6%	51.4%	100.0%
	Total			Count	167	175
					48.8%	51.2%
Treatment	To save energy, I turn off lights at home when I don't need them	False	Count	28	40	68
				41.2%	58.8%	100.0%
		True	Count	231	233	464
				49.8%	50.2%	100.0%
	Total			Count	259	273
					48.7%	51.3%

Question #5: "I have asked my family to recycle some of the things we use."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I have asked my family to recycle some of the things we use	False	Count	49	62	111
				44.1%	55.9%	100.0%
		True	Count	119	113	232
				51.3%	48.7%	100.0%
	Total			Count	168	175
					49.0%	51.0%
Treatment	I have asked my family to recycle some of the things we use	False	Count	75	78	153
				49.0%	51.0%	100.0%
		True	Count	187	193	380
				49.2%	50.8%	100.0%
	Total			Count	262	271
					49.2%	50.8%

Question #6: "I do NOT let a water faucet run when it is not necessary."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I do NOT let a water faucet run when it is not necessary	False	Count	17	12	29
				58.6%	41.4%	100.0%
		True	Count	151	163	314
				48.1%	51.9%	100.0%
	Total			Count	168	175
					49.0%	51.0%
Treatment	I do NOT let a water faucet run when it is not necessary	False	Count	17	21	38
				44.7%	55.3%	100.0%
		True	Count	245	251	496
				49.4%	50.6%	100.0%
	Total			Count	262	272
					49.1%	50.9%

Question #7: "I do NOT separate things at home for recycling."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I do NOT separate things at home for recycling	False	Count	64	64	128
				50.0%	50.0%	100.0%
		True	Count	105	112	217
				48.4%	51.6%	100.0%
	Total	Count		169	176	345
				49.0%	51.0%	100.0%
Treatment	I do NOT separate things at home for recycling	False	Count	90	105	195
				46.2%	53.8%	100.0%
		True	Count	171	168	339
				50.4%	49.6%	100.0%
	Total	Count		261	273	534
				48.9%	51.1%	100.0%

Question #8: "I like to learn about nature."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I like to learn about nature	False	Count	12	7	19
				63.2%	36.8%	100.0%
		True	Count	156	169	325
				48.0%	52.0%	100.0%
	Total	Count		168	176	344
				48.8%	51.2%	100.0%
Treatment	I like to learn about nature	False	Count	29	17	46
				63.0%	37.0%	100.0%
		True	Count	232	255	487
				47.6%	52.4%	100.0%
	Total	Count		261	272	533
				49.0%	51.0%	100.0%

Question #9: "I am frightened to think people don't care about the environment."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I am frightened to think people don't care about the environment	False	Count	49	51	100
				49.0%	51.0%	100.0%
		True	Count	120	125	245
				49.0%	51.0%	100.0%
	Total		Count	169	176	345
				49.0%	51.0%	100.0%
Treatment	I am frightened to think people don't care about the environment	False	Count	81	79	160
				50.6%	49.4%	100.0%
		True	Count	180	191	371
				48.5%	51.5%	100.0%
	Total		Count	261	270	531
				49.2%	50.8%	100.0%

Question #10: "I get angry about the damage pollution does to the environment."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I get angry about the damage pollution does to the environment	False	Count	37	19	56
				66.1%	33.9%	100.0%
		True	Count	132	157	289
				45.7%	54.3%	100.0%
	Total		Count	169	176	345
				49.0%	51.0%	100.0%
Treatment	I get angry about the damage pollution does to the environment	False	Count	42	34	76
				55.3%	44.7%	100.0%
		True	Count	218	236	454
				48.0%	52.0%	100.0%
	Total		Count	260	270	530
				49.1%	50.9%	100.0%

Question #11: "It makes me happy to see people recycle used bottles, cans, and paper."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	It makes me happy when people recycle used bottles, cans, and paper	False	Count	18	9	27
				66.7%	33.3%	100.0%
		True	Count	150	166	316
				47.5%	52.5%	100.0%
	Total		Count	168	175	343
				49.0%	51.0%	100.0%
Treatment	It makes me happy when people recycle used bottles, cans, and paper	False	Count	31	21	52
				59.6%	40.4%	100.0%
		True	Count	229	250	479
				47.8%	52.2%	100.0%
	Total		Count	260	271	531
				49.0%	51.0%	100.0%

Question #12: "It makes me happy to see people trying to save energy."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	It makes me happy to see people trying to save energy	False	Count	20	13	33
				60.6%	39.4%	100.0%
		True	Count	147	161	308
				47.7%	52.3%	100.0%
	Total		Count	167	174	341
				49.0%	51.0%	100.0%
Treatment	It makes me happy to see people trying to save energy	False	Count	34	20	54
				63.0%	37.0%	100.0%
		True	Count	227	253	480
				47.3%	52.7%	100.0%
	Total		Count	261	273	534
				48.9%	51.1%	100.0%

Question #13: "I am NOT worried about running out of water in my town."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I am NOT worried about running out of water in my town	False	Count	64	56	120
				53.3%	46.7%	100.0%
		True	Count	105	119	224
				46.9%	53.1%	100.0%
	Total	Count	169	175	344	
			49.1%	50.9%	100.0%	
Treatment	I am NOT worried about running out of water in my town	False	Count	86	68	154
				55.8%	44.2%	100.0%
		True	Count	174	203	377
				46.2%	53.8%	100.0%
	Total	Count	260	271	531	
			49.0%	51.0%	100.0%	

Question #14: "I get upset when I think of the things people throw away that could be recycled."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I get upset when I think of the things people throw away that could be recycled	False	Count	51	42	93
				54.8%	45.2%	100.0%
		True	Count	118	134	252
				46.8%	53.2%	100.0%
	Total	Count	169	176	345	
			49.0%	51.0%	100.0%	
Treatment	I get upset when I think of the things people throw away that could be recycled	False	Count	88	87	175
				50.3%	49.7%	100.0%
		True	Count	174	185	359
				48.5%	51.5%	100.0%
	Total	Count	262	272	534	
			49.1%	50.9%	100.0%	

Question #15: "It upsets me when I see people use too much water."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	It upsets me when I see people use too much water	False	Count	54	46	100
				54.0%	46.0%	100.0%
		True	Count	114	129	243
				46.9%	53.1%	100.0%
	Total	Count	168	175	343	
			49.0%	51.0%	100.0%	
Treatment	It upsets me when I see people use too much water.	False	Count	72	96	168
				42.9%	57.1%	100.0%
		True	Count	188	176	364
				51.6%	48.4%	100.0%
	Total	Count	260	272	532	
			48.9%	51.1%	100.0%	

Question #16: "I do NOT worry about wetlands being changed by people building on them."

				Pre- or Post-test		
Treatment or Control				Post-test	Pre-test	Total
Control	I do NOT worry about wetlands being changed by people building on them	False	Count	28	38	66
				42.4%	57.6%	100.0%
		True	Count	141	136	277
				50.9%	49.1%	100.0%
	Total	Count	169	174	343	
			49.3%	50.7%	100.0%	
Treatment	I do NOT worry about wetlands being changed by people building on them	False	Count	38	41	79
				48.1%	51.9%	100.0%
		True	Count	224	231	455
				49.2%	50.8%	100.0%
	Total	Count	262	272	534	
			49.1%	50.9%	100.0%	

Question #17: "I get worried about farm run-off that may be going into the ocean."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I get worried about farm run-off that may be going into the ocean	False	Count	33	35	68
				48.5%	51.5%	100.0%
		True	Count	135	140	275
				49.1%	50.9%	100.0%
	Total		Count	168	175	343
				49.0%	51.0%	100.0%
Treatment	I get worried about farm run-off that may be going into the ocean	False	Count	61	65	126
				48.4%	51.6%	100.0%
		True	Count	201	208	409
				49.1%	50.9%	100.0%
	Total		Count	262	273	535
				49.0%	51.0%	100.0%

Question #18: "I worry because there are very few wetland areas left in California."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I worry because there are very few wetland areas left in California	False	Count	40	43	83
				48.2%	51.8%	100.0%
		True	Count	128	133	261
				49.0%	51.0%	100.0%
	Total		Count	168	176	344
				48.8%	51.2%	100.0%
Treatment	I worry because there are very few wetland areas left in California	False	Count	71	58	129
				55.0%	45.0%	100.0%
		True	Count	191	215	406
				47.0%	53.0%	100.0%
	Total		Count	262	273	535
				49.0%	51.0%	100.0%

Question #19: "I feel that people in government know a lot about protecting our environment."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I feel that people in government know a lot about protecting our environment	False	Count	99	112	211
				46.9%	53.1%	100.0%
		True	Count	69	63	132
				52.3%	47.7%	100.0%
	Total		Count	168	175	343
				49.0%	51.0%	100.0%
Treatment	I feel that people in government know a lot about protecting our environment	False	Count	149	169	318
				46.9%	53.1%	100.0%
		True	Count	110	101	211
				52.1%	47.9%	100.0%
	Total		Count	259	270	529
				49.0%	51.0%	100.0%

Question #20: "I do NOT like to go out into nature areas because of animals that can hurt me."

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	I do NOT like to go out into nature areas because of animals that can hurt me	False	Count	29	56	85
				34.1%	65.9%	100.0%
		True	Count	137	118	255
				53.7%	46.3%	100.0%
	Total		Count	166	174	340
				48.8%	51.2%	100.0%
Treatment	I do NOT like to go out into nature areas because of animals that can hurt me	False	Count	50	46	96
				52.1%	47.9%	100.0%
		True	Count	212	225	437
				48.5%	51.5%	100.0%
	Total		Count	262	271	533
				49.2%	50.8%	100.0%

Knowledge Questions

Question #1: "Where does most of the garbage go after it is dumped from the garbage trucks?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Where does most of the garbage go after it is dumped from the trucks?	Dumped into the ocean	Count	26	26	52
				50.0%	50.0%	100.0%
		Recycled to make plastic	Count	52	67	119
				43.7%	56.3%	100.0%
		To a landfill where it is buried	Count	75	73	148
				50.7%	49.3%	100.0%
Treatment	Where does most of the garbage go after it is dumped from the trucks?	To farmers for use as fertilizer	Count	15	8	23
				65.2%	34.8%	100.0%
		Total	Count	168	174	342
				49.1%	50.9%	100.0%
		Dumped into the ocean	Count	29	34	63
				46.0%	54.0%	100.0%
Treatment	Where does most of the garbage go after it is dumped from the trucks?	Recycled to make plastic	Count	79	93	172
				45.9%	54.1%	100.0%
		To a landfill where it is buried	Count	132	119	251
				52.6%	47.4%	100.0%
		To farmers for use as fertilizer	Count	22	27	49
				44.9%	55.1%	100.0%
Total		Total	Count	262	273	535
				49.0%	51.0%	100.0%

Question #2: "Environmental problems are a threat to:"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Environmental problems are a threat to:	Only people who live in cities	Count	2	6	8
				25.0%	75.0%	100.0%
		Only wild animals and endangered species	Count	11	23	34
				32.4%	67.6%	100.0%
		Mostly tropical plants and animals	Count	16	18	34
				47.1%	52.9%	100.0%
Treatment	Environmental problems are a threat to:	All living things in the world	Count	137	129	266
				51.5%	48.5%	100.0%
		Total	Count	166	176	342
				48.5%	51.5%	100.0%
		Only people who live in cities	Count	10	15	25
				40.0%	60.0%	100.0%
Treatment	Environmental problems are a threat to:	Only wild animals and endangered species	Count	30	38	68
				44.1%	55.9%	100.0%
		Mostly tropical plants and animals	Count	22	15	37
				59.5%	40.5%	100.0%
		All living things in the world	Count	199	204	403
				49.4%	50.6%	100.0%
Total		Total	Count	261	272	533
				49.0%	51.0%	100.0%

Question #3: "Where is water under the ground found?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Where is water under the ground found?	In landfills	Count	46	32	78
				59.0%	41.0%	100.0%
		In ponds	Count	10	20	30
				33.3%	66.7%	100.0%
		In aquifers	Count	68	75	143
				47.6%	52.4%	100.0%
		In rivers	Count	43	47	90
Treatment	Where is water under the ground found?			47.8%	52.2%	100.0%
		Total	Count	167	174	341
				49.0%	51.0%	100.0%
		In landfills	Count	70	68	138
				50.7%	49.3%	100.0%
		In ponds	Count	29	35	64
				45.3%	54.7%	100.0%
		In aquifers	Count	107	92	199
				53.8%	46.2%	100.0%
		In rivers	Count	55	76	131
				42.0%	58.0%	100.0%
		Total	Count	261	271	532
				49.1%	50.9%	100.0%

Question #4: "An item which can not be recycled and used again is:"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	An item which can NOT be recycled and used again is:	Disposable diapers	Count	70	67	137
				51.1%	48.9%	100.0%
		Newspapers	Count	5	6	11
				45.5%	54.5%	100.0%
		Motor oil	Count	82	90	172
				47.7%	52.3%	100.0%
		Plastic bottles	Count	11	13	24
Treatment	An item which can NOT be recycled and used again is:			45.8%	54.2%	100.0%
		Total	Count	168	176	344
				48.8%	51.2%	100.0%
		Disposable diapers	Count	105	111	216
				48.6%	51.4%	100.0%
		Newspapers	Count	3	12	15
				20.0%	80.0%	100.0%
		Motor oil	Count	136	134	270
				50.4%	49.6%	100.0%
		Plastic bottles	Count	18	15	33
				54.5%	45.5%	100.0%
		Total	Count	262	272	534
				49.1%	50.9%	100.0%

Question #5: "What is the beginning (bottom) of the marine food web?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	The beginning of the marine food web?	Crabs	Count	11	18	29
				37.9%	62.1%	100.0%
		Fish	Count	24	25	49
				49.0%	51.0%	100.0%
		Plant plankton	Count	117	108	225
				52.0%	48.0%	100.0%
Treatment	The beginning of the marine food web?	Sea snails	Count	17	24	41
				41.5%	58.5%	100.0%
		Total	Count	169	175	344
				49.1%	50.9%	100.0%
		Crabs	Count	24	31	55
				43.6%	56.4%	100.0%
Control	The beginning of the marine food web?	Fish	Count	37	49	86
				43.0%	57.0%	100.0%
		Plant plankton	Count	180	155	335
				53.7%	46.3%	100.0%
		Sea snails	Count	20	36	56
				35.7%	64.3%	100.0%
Treatment	The beginning of the marine food web?	Total	Count	261	271	532
				49.1%	50.9%	100.0%

Question #6: "Why is a wetland an important place?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Why is a wetland an important place?	It catches water for people to drink	Count	30	28	58
				51.7%	48.3%	100.0%
		It filters water and provides a nursery ground for fish/bird	Count	108	107	215
				50.2%	49.8%	100.0%
		It cools the air	Count	7	12	19
				36.8%	63.2%	100.0%
Treatment	Why is a wetland an important place?	It protects us from large waves from the ocean	Count	24	27	51
				47.1%	52.9%	100.0%
		Total	Count	169	174	343
				49.3%	50.7%	100.0%
		It catches water for people to drink	Count	36	45	81
				44.4%	55.6%	100.0%
Control	Why is a wetland an important place?	It filters water and provides a nursery ground for fish/bird	Count	183	181	364
				50.3%	49.7%	100.0%
		It cools the air	Count	23	23	46
				50.0%	50.0%	100.0%
		It protects us from large waves from the ocean	Count	20	23	43
				46.5%	53.5%	100.0%
Treatment	Why is a wetland an important place?	Total	Count	262	272	534
				49.1%	50.9%	100.0%

Question #7: "Non-native plants:"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Non-native plants:	Give us food to eat	Count	28	24	52
				53.8%	46.2%	100.0%
		Leave little space for native plants to grow	Count	27	29	56
				48.2%	51.8%	100.0%
		Are good because they grow well at E.S.	Count	33	32	65
				50.8%	49.2%	100.0%
		Provide good habitat for native animals	Count	80	90	170
				47.1%	52.9%	100.0%
	Total		Count	168	175	343
				49.0%	51.0%	100.0%
Treatment	Non-native plants:	Give us food to eat	Count	19	38	57
				33.3%	66.7%	100.0%
		Leave little space for native plants to grow	Count	101	73	174
				58.0%	42.0%	100.0%
		Are good because they grow well at E.S.	Count	37	40	77
				48.1%	51.9%	100.0%
		Provide good habitat for native animals	Count	105	116	221
				47.5%	52.5%	100.0%
	Total		Count	262	267	529
				49.5%	50.5%	100.0%

Question #8: "Elkhorn Slough needs to be protected because:"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	E.S. needs protection because:	It provides habitat for many plants and animals	Count	66	63	131
				50.4%	49.6%	100.0%
		It filters pollutants from water run-off from the land	Count	4	11	15
				26.7%	73.3%	100.0%
		It provides a place for migrating birds to rest	Count	9	13	22
				40.9%	59.1%	100.0%
		All of the above	Count	90	86	176
				51.1%	48.9%	100.0%
	Total		Count	169	175	344
				49.1%	50.9%	100.0%
Treatment	E.S. needs protection because:	It provides habitat for many plants and animals	Count	83	108	191
				43.5%	56.5%	100.0%
		It filters pollutants from water run-off from the land	Count	8	11	19
				42.1%	57.9%	100.0%
		It provides a place for migrating birds to rest	Count	17	19	36
				47.2%	52.8%	100.0%
		All of the above	Count	154	135	289
				53.3%	46.7%	100.0%
	Total		Count	262	273	535
				49.0%	51.0%	100.0%

Question #9: "People are monitoring the Slough. Why?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Why are people monitoring the Slough?	To better understand the health of the Slough	Count	50	48	98
				51.0%	49.0%	100.0%
		College students need research projects	Count	36	49	85
				42.4%	57.6%	100.0%
		To make sure no one dumps trash in the Slough	Count	71	57	128
				55.5%	44.5%	100.0%
		It is a nice place to work	Count	12	21	33
				36.4%	63.6%	100.0%
	Total		Count	169	175	344
				49.1%	50.9%	100.0%
Treatment	Why are people monitoring the Slough?	To better understand the health of the Slough	Count	103	87	190
				54.2%	45.8%	100.0%
		College students need research projects	Count	31	44	75
				41.3%	58.7%	100.0%
		To make sure no one dumps trash in the Slough	Count	103	113	216
				47.7%	52.3%	100.0%
		It is a nice place to work	Count	23	27	50
				46.0%	54.0%	100.0%
	Total		Count	260	271	531
				49.0%	51.0%	100.0%

Question #10: "Tides come in and out of Elkhorn Slough:"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Tides come in and out of E.S.:	Two times a day	Count	49	44	93
				52.7%	47.3%	100.0%
		One time a day	Count	36	41	77
				46.8%	53.2%	100.0%
		Never	Count	26	43	69
				37.7%	62.3%	100.0%
		Three times a day	Count	58	47	105
				55.2%	44.8%	100.0%
	Total		Count	169	175	344
				49.1%	50.9%	100.0%
Treatment	Tides come in and out of E.S.:	Two times a day	Count	135	78	213
				63.4%	36.6%	100.0%
		One time a day	Count	45	50	95
				47.4%	52.6%	100.0%
		Never	Count	23	77	100
				23.0%	77.0%	100.0%
		Three times a day	Count	56	68	124
				45.2%	54.8%	100.0%
	Total		Count	259	273	532
				48.7%	51.3%	100.0%

Question #11: "What does biodiversity mean?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	What does biodiversity mean?	There a lot of plants in an area	Count	21 44.7%	26 55.3%	47 100.0%
		Plants and animals that are alive	Count	38 45.2%	46 54.8%	84 100.0%
		Many types of plants and animals in an area	Count	89 52.7%	80 47.3%	169 100.0%
		There are a lot of birds in an area	Count	19 45.2%	23 54.8%	42 100.0%
		Total	Count	167 48.8%	175 51.2%	342 100.0%
Treatment	What does biodiversity mean?	There a lot of plants in an area	Count	21 44.7%	26 55.3%	47 100.0%
		Plants and animals that are alive	Count	61 54.0%	52 46.0%	113 100.0%
		Many types of plants and animals in an area	Count	129 47.1%	145 52.9%	274 100.0%
		There are a lot of birds in an area	Count	48 52.7%	43 47.3%	91 100.0%
		Total	Count	259 49.3%	266 50.7%	525 100.0%

Question #12: "Elkhorn Slough has different habitats. What are they?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	What are the different habitats at E.S.	Mud flats, Uplands, Saltmarsh	Count	87 49.7%	88 50.3%	175 100.0%
		Tropical forests, Sandy beach, Coral reefs	Count	29 47.5%	32 52.5%	61 100.0%
		Redwood forests, Mud flats, Desert	Count	29 67.4%	14 32.6%	43 100.0%
		Desert, Grassland, Sandy beach	Count	24 36.9%	41 63.1%	65 100.0%
		Total	Count	169 49.1%	175 50.9%	344 100.0%
Treatment	What are the different habitats at E.S.	Mud flats, Uplands, Saltmarsh	Count	199 53.6%	172 46.4%	371 100.0%
		Tropical forests, Sandy beach, Coral reefs	Count	23 36.5%	40 63.5%	63 100.0%
		Redwood forests, Mud flats, Desert	Count	15 36.6%	26 63.4%	41 100.0%
		Desert, Grassland, Sandy beach	Count	22 40.0%	33 60.0%	55 100.0%
		Total	Count	259 48.9%	271 51.1%	530 100.0%

Question #13: "What does the word 'watershed' mean?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	What does the word "watershed" mean?	It is a place that holds water	Count	91 46.9%	103 53.1%	194 100.0%
		It is a land area where water drains to the oceans or rivers	Count	53 52.0%	49 48.0%	102 100.0%
		Another name for a roof that protects people from the rain	Count	16 50.0%	16 50.0%	32 100.0%
		It is a type of boat	Count	8 53.3%	7 46.7%	15 100.0%
		Total	Count	168 49.0%	175 51.0%	343 100.0%
	What does the word "watershed" mean?	It is a place that holds water	Count	141 48.0%	153 52.0%	294 100.0%
		It is a land area where water drains to the oceans or rivers	Count	69 49.3%	71 50.7%	140 100.0%
		Another name for a roof that protects people from the rain	Count	44 55.7%	35 44.3%	79 100.0%
		It is a type of boat	Count	7 41.2%	10 58.8%	17 100.0%
		Total	Count	261 49.2%	269 50.8%	530 100.0%

Question #14: "Natural areas are protected:"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Natural areas are protected:	To keep people from damaging the land	Count	36 59.0%	25 41.0%	61 100.0%
		So people can use the land to learn about plants and animals	Count	13 43.3%	17 56.7%	30 100.0%
		So that plants and animals will have a home	Count	33 44.0%	42 56.0%	75 100.0%
		All of the above	Count	86 48.9%	90 51.1%	176 100.0%
		Total	Count	168 49.1%	174 50.9%	342 100.0%
	Natural areas are protected:	To keep people from damaging the land	Count	36 45.0%	44 55.0%	80 100.0%
		So people can use the land to learn about plants and animals	Count	23 43.4%	30 56.6%	53 100.0%
		So that plants and animals will have a home	Count	44 45.4%	53 54.6%	97 100.0%
		All of the above	Count	157 52.7%	141 47.3%	298 100.0%
		Total	Count	260 49.2%	268 50.8%	528 100.0%

Question #15: "Do the things you do at home effect the ocean?"

Treatment or Control		Pre- or Post-test		Total
		Post-test	Pre-test	
Control	Do the things you do at home effect the ocean?	No, I live too far from the ocean	Count 30 41.1%	43 58.9% 100.0%
		Yes, I live close to the ocean	Count 10 50.0%	10 50.0% 100.0%
		Yes, pollution drains into the street and out to the ocean	Count 77 50.7%	75 49.3% 100.0%
		No, my house is surrounded by other houses	Count 50 51.0%	48 49.0% 100.0%
		1 and 4	Count 1 100.0%	1 100.0%
		Total	Count 168 48.8%	176 51.2% 100.0%
Treatment	Do the things you do at home effect the ocean?	No, I live too far from the ocean	Count 48 41.7%	67 58.3% 100.0%
		Yes, I live close to the ocean	Count 21 52.5%	19 47.5% 100.0%
		Yes, pollution drains into the street and out to the ocean	Count 108 48.4%	115 51.6% 100.0%
		No, my house is surrounded by other houses	Count 84 55.6%	67 44.4% 100.0%
		Total	Count 261 49.3%	268 50.7% 100.0%

Question #16: "What animals can live in a mudflat?"

Treatment or Control		Pre- or Post-test		Total
		Post-test	Pre-test	
Control	What animals can live in a mudflat?	Sea star	Count 12 46.2%	14 53.8% 100.0%
		Clams	Count 30 47.6%	33 52.4% 100.0%
		Hermit crabs	Count 52 46.4%	60 53.6% 100.0%
		All of the above	Count 75 52.1%	69 47.9% 100.0%
		Total	Count 169 49.0%	176 51.0% 100.0%
Treatment	What animals can live in a mudflat?	Sea star	Count 9 32.1%	19 67.9% 100.0%
		Clams	Count 33 50.0%	33 50.0% 100.0%
		Hermit crabs	Count 96 48.7%	101 51.3% 100.0%
		All of the above	Count 123 52.1%	113 47.9% 100.0%
		Total	Count 261 49.5%	266 50.5% 100.0%

Question #17: "Which of these statements is TRUE about a saltmarsh?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Which statement is TRUE about a saltmarsh?	It is too salty for plants	Count	13 50.0%	13 50.0%	26 100.0%
		It is too salty for animals	Count	12 40.0%	18 60.0%	30 100.0%
		Only a few types of plants can live in the salty soil	Count	102 49.8%	103 50.2%	205 100.0%
		All of the above	Count	42 50.6%	41 49.4%	83 100.0%
		Total	Count	169 49.1%	175 50.9%	344 100.0%
Treatment	Which statement is TRUE about a saltmarsh?	It is too salty for plants	Count	11 44.0%	14 56.0%	25 100.0%
		It is too salty for animals	Count	28 47.5%	31 52.5%	59 100.0%
		Only a few types of plants can live in the salty soil	Count	160 51.1%	153 48.9%	313 100.0%
		All of the above	Count	62 47.0%	70 53.0%	132 100.0%
		Total	Count	261 49.3%	268 50.7%	529 100.0%

Question #18: "What was Elkhorn Slough used for before it became a nature preserve?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	What was E.S. used for before it became a nature preserve?	Dairy	Count	60 55.0%	49 45.0%	109 100.0%
		Rice farm	Count	37 43.0%	49 57.0%	86 100.0%
		Airport	Count	17 56.7%	13 43.3%	30 100.0%
		Golf Course	Count	55 46.6%	63 53.4%	118 100.0%
		Total	Count	169 49.3%	174 50.7%	343 100.0%
Treatment	What was E.S. used for before it became a nature preserve?	Dairy	Count	179 69.6%	78 30.4%	257 100.0%
		Rice farm	Count	48 35.0%	89 65.0%	137 100.0%
		Airport	Count	11 45.8%	13 54.2%	24 100.0%
		Golf Course	Count	23 21.7%	83 78.3%	106 100.0%
		Total	Count	261 49.8%	263 50.2%	524 100.0%

Question #19: "Which of these statements is TRUE about mudflats?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Which of these statements is TRUE about mudflats?	They are never covered by water	Count	25 45.5%	30 54.5%	55 100.0%
		They are home to many animals	Count	105 49.1%	109 50.9%	214 100.0%
		They provide a feeding ground for gray whales	Count	24 52.2%	22 47.8%	46 100.0%
		There is no oxygen and animals can not live there	Count	15 50.0%	15 50.0%	30 100.0%
		Total	Count	169 49.0%	176 51.0%	345 100.0%
Treatment	Which of these statements is TRUE about mudflats?	They are never covered by water	Count	44 48.9%	46 51.1%	90 100.0%
		They are home to many animals	Count	177 51.2%	169 48.8%	346 100.0%
		They provide a feeding ground for gray whales	Count	16 34.8%	30 65.2%	46 100.0%
		There is no oxygen and animals can not live there	Count	22 48.9%	23 51.1%	45 100.0%
		Total	Count	259 49.1%	268 50.9%	527 100.0%

Question #20: "The land which surrounds Elkhorn Slough has many uses. What are some of these uses?"

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	What are the landuses around E.S.?	Agriculture, dairies	Count	76 49.7%	77 50.3%	153 100.0%
		Junk yard	Count	9 52.9%	8 47.1%	17 100.0%
		Power plant	Count	45 44.6%	56 55.4%	101 100.0%
		All of the above	Count	39 52.7%	35 47.3%	74 100.0%
		Total	Count	169 49.0%	176 51.0%	345 100.0%
Treatment	What are the landuses around E.S.?	Agriculture, dairies	Count	101 48.1%	109 51.9%	210 100.0%
		Junk yard	Count	7 31.8%	15 68.2%	22 100.0%
		Power plant	Count	85 55.6%	68 44.4%	153 100.0%
		All of the above	Count	68 47.2%	76 52.8%	144 100.0%
		Total	Count	261 49.3%	268 50.7%	529 100.0%

Picture Knowledge Questions

“Tell us where these animals or plants live.”

Question #1: Jellyfish

Treatment or Control		Pre- or Post-test		Total		
		Post-test	Pre-test			
Control	Jelly Fish	Salt Marsh	Count	2	4	6
				33.3%	66.7%	100.0%
		Mudflats	Count	1	1	2
				50.0%	50.0%	100.0%
		Uplands	Count	1	3	4
				25.0%	75.0%	100.0%
	Always in the water	Count	164	165	329	
		49.8%	50.2%	100.0%		
	Total	Count	168	173	341	
			49.3%	50.7%	100.0%	
Treatment	Jelly Fish	Salt Marsh	Count	12	12	24
				50.0%	50.0%	100.0%
		Mudflats	Count	3	1	4
				75.0%	25.0%	100.0%
		Uplands	Count	2	1	3
				66.7%	33.3%	100.0%
	Always in the water	Count	243	257	500	
		48.6%	51.4%	100.0%		
	Total	Count	260	271	531	
			49.0%	51.0%	100.0%	

Question #2: Mouse

Treatment or Control		Pre- or Post-test			Total	
		Post-test	Pre-test			
Control	Mouse	Salt Marsh	Count	9	6	15
				60.0%	40.0%	100.0%
		Mudflats	Count	5	11	16
				31.3%	68.8%	100.0%
		Uplands	Count	154	155	309
			49.8%	50.2%	100.0%	
	Always in the water	Count		1	1	
			100.0%	100.0%		
	Total	Count	168	173	341	
			49.3%	50.7%	100.0%	
Treatment	Mouse	Salt Marsh	Count	4	7	11
				36.4%	63.6%	100.0%
		Mudflats	Count	10	19	29
				34.5%	65.5%	100.0%
		Uplands	Count	247	239	486
			50.8%	49.2%	100.0%	
	Always in the water	Count		3	3	
			100.0%	100.0%		
	Total	Count	261	268	529	
			49.3%	50.7%	100.0%	

Question #3: Plankton

				Pre- or Post-test		
Treatment or Control				Post-test	Pre-test	Total
Control	Plankton	Salt Marsh	Count	27	33	60
				45.0%	55.0%	100.0%
		Mudflats	Count	31	33	64
				48.4%	51.6%	100.0%
		Uplands	Count	10	15	25
			40.0%	60.0%	100.0%	
	Always in the water	Count	101	90	191	
			52.9%	47.1%	100.0%	
		Total	Count	169	171	340
				49.7%	50.3%	100.0%
Treatment		Plankton	Salt Marsh	Count	60	52
				53.6%	46.4%	100.0%
	Mudflats		Count	47	68	115
				40.9%	59.1%	100.0%
	Uplands		Count	14	24	38
			36.8%	63.2%	100.0%	
	Always in the water	Count	140	127	267	
			52.4%	47.6%	100.0%	
		Total	Count	261	271	532
				49.1%	50.9%	100.0%

Question #4: Pickleweed

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Pickleweed	Salt Marsh	Count	82	72	154
				53.2%	46.8%	100.0%
		Mudflats	Count	35	33	68
				51.5%	48.5%	100.0%
		Uplands	Count	36	38	74
				48.6%	51.4%	100.0%
		Always in the water	Count	16	30	46
				34.8%	65.2%	100.0%
		Total	Count	169	173	342
				49.4%	50.6%	100.0%
Treatment	Pickleweed	Salt Marsh	Count	122	87	209
				58.4%	41.6%	100.0%
		Mudflats	Count	60	75	135
				44.4%	55.6%	100.0%
		Uplands	Count	62	71	133
				46.6%	53.4%	100.0%
		Always in the water	Count	17	34	51
				33.3%	66.7%	100.0%
		Total	Count	261	267	528
				49.4%	50.6%	100.0%

Question #5: Fat innkeeper worm

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Fat innkeeper worm	Salt Marsh	Count	15	27	42
				35.7%	64.3%	100.0%
		Mudflats	Count	126	105	231
				54.5%	45.5%	100.0%
		Uplands	Count	17	24	41
				41.5%	58.5%	100.0%
		Always in the water	Count	10	14	24
				41.7%	58.3%	100.0%
	Total		Count	168	170	338
				49.7%	50.3%	100.0%
Treatment	Fat innkeeper worm	Salt Marsh	Count	34	52	86
				39.5%	60.5%	100.0%
		Mudflats	Count	193	167	360
				53.6%	46.4%	100.0%
		Uplands	Count	25	28	53
				47.2%	52.8%	100.0%
		Always in the water	Count	9	22	31
				29.0%	71.0%	100.0%
	Total		Count	261	269	530
				49.2%	50.8%	100.0%

Question #6: Snake

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Snake	Salt Marsh	Count	15	19	34
				44.1%	55.9%	100.0%
		Mudflats	Count	23	25	48
				47.9%	52.1%	100.0%
		Uplands	Count	130	124	254
				51.2%	48.8%	100.0%
		Always in the water	Count	1	3	4
				25.0%	75.0%	100.0%
	Total		Count	169	171	340
				49.7%	50.3%	100.0%
Treatment	Snake	Salt Marsh	Count	12	19	31
				38.7%	61.3%	100.0%
		Mudflats	Count	24	60	84
				28.6%	71.4%	100.0%
		Uplands	Count	224	180	404
				55.4%	44.6%	100.0%
		Always in the water	Count	2	8	10
				20.0%	80.0%	100.0%
	Total		Count	262	267	529
				49.5%	50.5%	100.0%

Question #7: Moon Snail

Treatment or Control				Pre- or Post-test		Total	
				Post-test	Pre-test		
Control	Moon Snail	Salt Marsh	Count	31 60.8%	20 39.2%	51 100.0%	
		Mudflats	Count	73 53.7%	63 46.3%	136 100.0%	
		Uplands	Count	37 38.1%	60 61.9%	97 100.0%	
		Always in the water	Count	27 50.0%	27 50.0%	54 100.0%	
		Total	Count	168 49.7%	170 50.3%	338 100.0%	
	Treatment	Moon Snail	Salt Marsh	Count	53 47.7%	58 52.3%	111 100.0%
			Mudflats	Count	113 53.8%	97 46.2%	210 100.0%
Uplands			Count	65 44.2%	82 55.8%	147 100.0%	
Always in the water			Count	31 51.7%	29 48.3%	60 100.0%	
Total		Count	262 49.6%	266 50.4%	528 100.0%		

Question #8: Salt Grass

Treatment or Control				Pre- or Post-test		Total	
				Post-test	Pre-test		
Control	Salt Grass	Salt Marsh	Count	127 50.6%	124 49.4%	251 100.0%	
		Mudflats	Count	12 44.4%	15 55.6%	27 100.0%	
		Uplands	Count	14 42.4%	19 57.6%	33 100.0%	
		Always in the water	Count	14 51.9%	13 48.1%	27 100.0%	
		Total	Count	167 49.4%	171 50.6%	338 100.0%	
	Treatment	Salt Grass	Salt Marsh	Count	202 50.1%	201 49.9%	403 100.0%
			Mudflats	Count	22 61.1%	14 38.9%	36 100.0%
Uplands			Count	24 42.9%	32 57.1%	56 100.0%	
Always in the water			Count	11 37.9%	18 62.1%	29 100.0%	
Total			Count	259 49.4%	265 50.6%	524 100.0%	

Question #9: Poison Oak

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Poison Oak	Salt Marsh	Count	14	10	24
				58.3%	41.7%	100.0%
		Mudflats	Count	8	16	24
				33.3%	66.7%	100.0%
		Uplands	Count	143	144	287
			49.8%	50.2%	100.0%	
	Always in the water	Count	3	2	5	
				60.0%	40.0%	100.0%
	Total	Count	168	172	340	
				49.4%	50.6%	100.0%
Treatment	Poison Oak	Salt Marsh	Count	12	21	33
				36.4%	63.6%	100.0%
		Mudflats	Count	18	19	37
				48.6%	51.4%	100.0%
		Uplands	Count	231	222	453
			51.0%	49.0%	100.0%	
	Always in the water	Count	1	6	7	
				14.3%	85.7%	100.0%
	Total	Count	262	268	530	
				49.4%	50.6%	100.0%

Question #10: Shark

Treatment or Control				Pre- or Post-test		Total
				Post-test	Pre-test	
Control	Shark	Salt Marsh	Count	1 33.3%	2 66.7%	3 100.0%
		Mudflats	Count	1 100.0%		1 100.0%
		Uplands	Count	5 62.5%	3 37.5%	8 100.0%
		Always in the water	Count	162 48.9%	169 51.1%	331 100.0%
		Total	Count	169 49.3%	174 50.7%	343 100.0%
		Treatment				
	Shark	Salt Marsh	Count	5 38.5%	8 61.5%	13 100.0%
Mudflats		Count	1 50.0%	1 50.0%	2 100.0%	
Uplands		Count	3 100.0%		3 100.0%	
Always in the water		Count	253 49.1%	262 50.9%	515 100.0%	
Total		Count	262 49.2%	271 50.8%	533 100.0%	