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Major professor

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**THE GREAT LAKES EDUCATION PROGRAM:
AN IN-DEPTH EVALUATION OF PROGRAM IMPACTS ON
FOURTH GRADE STUDENTS**

By

Anne Williamson

A THESIS

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

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ABSTRACT

THE GREAT LAKES EDUCATION PROGRAM: AN IN-DEPTH EVALUATION OF PROGRAM IMPACTS ON FOURTH GRADE STUDENTS

By

Anne Williamson

The focus of this research was to measure the impacts of the Great Lakes Education Program (GLEP) vessel experience on fourth grade students' changes in Great Lakes knowledge, attitudes toward the Great Lakes, and responsible behavioral intentions. A valid and reliable written survey was developed from eight pre-existing instruments. The study incorporated a quasi-experimental, pre- post-test design involving 39 fourth grade classrooms (945 students). Students exhibited a highly significant increase in Great Lakes knowledge, a significant increase in girls' positive attitudes toward the Great Lakes, and no change in responsible behavioral intentions as a result of the GLEP vessel experience. Additionally, girls had significantly higher pre- and post-cruise behavioral intentions than boys, and boys had significantly more Great Lakes and aquatic experiences than girls. Recommendations include conducting longer-term follow-up evaluations with students, improving measurement of attitudes and behavioral intentions, and strengthening cruise and written curricula.

To my mom, for her constant encouragment to follow my dreams, and
to my husband, who helped me reach this one.

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Chapter 1

INTRODUCTION

Problem Area

Vessel-based education programs are quite prevalent throughout the Great Lakes and United States. The American Sail Training Association (ASTA) publishes an annual *ASTA Directory of Sail Training Programs and Tall Ships*. This directory contains over 130 listings of sail-based education programs which cover various disciplines for students of all ages. Besides the ASTA directory entries, there are additional non-sail vessel education programs; four exist in Michigan alone, including the Great Lakes Education Program (GLEP).

The Great Lakes Education Program, developed by Michigan Sea Grant College Program and Michigan State University Extension, is a Great Lakes classroom and experiential learning program for fourth grade students. It specifically targets fourth grade students because Michigan's State Board of Education mandates that students learn about the Great Lakes in the fourth grade. The Great Lakes Education Program provides a multi-disciplinary introduction to the biological, physical, chemical, and cultural aspects of the Great Lakes and other aquatic systems. Currently, GLEP features a vessel-based educational experience which includes eight learning stations offered by shipboard

educators known as cruise leaders. The half-day cruise consists of a trip on the Clinton River and Lake St. Clair, which are within the Great Lakes watershed. In addition, GLEP's written curriculum consists of pre- and post-trip classroom activities to enhance the learning experience. The goal of GLEP is to educate youth to develop ecological literacy, understanding, and stewardship of Great Lakes resources and issues. This goal is consistent with the superordinate goal of environmental education (EE) which is,

“...to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment”
(Hungerford and Volk, 1990:13).

One assumption in the superordinate goal of EE is that knowledge is an essential prerequisite for responsible environmental behavior. Sound ecological understanding must be at the foundation of all decision making; Bennett (1989) states that “...cognitive skills progress in difficulty from knowledge to evaluation, and that each skill requires the use of skills below it; for example, application requires understanding requires knowledge” (Bennett, 1989:16). The superordinate goal also recognizes that when making decisions, the average person does not use knowledge alone because feelings and emotions are involved in the entire decision making process (Eiss and Harbeck, 1969). The key element to remember in designing programs to develop responsible environmental behavior is that there is no single component which can determine or influence environmental responsibility.

Recently, EE has been under fire in the general media for dealing with feelings,

emotions, sensitive issues, and controversial topics. Jo Kwong at George Mason University contends that EE, often referred to as “green” education, sometimes degenerates into “emotionalism, myths and misinformation” (Satchell, 1996:64). It is unfortunate that EE is often misunderstood and used interchangeably with environmentalism and environmental advocacy; the “principles of civic responsibility depend upon a firm understanding of environmental and social relationships” (Simmons, 1996:2).

Since we do understand that sound ecological knowledge is necessary for responsible environmental behavior, a major problem in the United States is low scientific and technological literacy. U.S. high school students rank low in student achievement in biology, chemistry, and physics; there are also very few students who are pursuing careers in technical fields (Maryland Sea Grant, 1993). An understanding of scientific processes, particularly related to Great Lakes aquatic sciences, will be extremely important to citizens of this basin in the future.

Not only is EE battling the problem of low scientific literacy, but, as noted in numerous articles, the lack of evaluation hinders the credibility of EE programs (Bennett, 1989; Brody, 1995; Brody and Koch, 1989; Ewert, 1987; Flor, 1991; Iozzi, 1989; Keen, 1991; Kolb, 1991; Leeming et al., 1993; Lisowski and Disinger, 1991; Lucko, Disinger, and Roth, 1982). In order to “...convince the educational community that EE can improve academic curricula and make traditional subjects more relevant to students, we *must* evaluate our programs” (Bennett, 1989:1). In addition, there is an even greater need for the evaluation of experiential education, or hands-on learning in field situations.

“Paramount in efforts to integrate experiential education into more mainstream learning will be the ability to provide more concrete evidence as to program accomplishments” (Flor, 1991:1).

Problem Statement

The vessel-based experience associated with GLEP has been extremely well received by participants, but there has been no detailed evaluation research to ascertain whether the vessel experience is achieving its desired impacts on students’ Great Lakes knowledge, attitudes, and intentions to perform responsible Great Lakes behaviors. Furthermore, no quasi-experimental evaluations have been conducted on any of the other vessel-based programs. Thus, the focus of this research is to measure the impacts of the GLEP vessel experience on students’ changes in Great Lakes knowledge, attitudes towards the Great Lakes, and responsible behavioral intentions regarding the Great Lakes.

Chapter 2

LITERATURE REVIEW

Brief Review of Environmental Education (EE)

Definitions and Philosophies of EE and Marine and Aquatic Education (M/AE)

Environmental education covers a wide range of topics focusing on quality education about the environment. Five objectives developed at the 1977 Tbilisi Intergovernmental Conference on Environmental Education, which support the superordinate goal of EE and help to concentrate educational efforts, are:

1. AWARENESS - to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems [and/or issues]
2. SENSITIVITY - to help social groups and individuals gain a variety of experiences in, and acquire a basic understanding of, the environment and its associated problems [and/or issues]
3. ATTITUDES - to help social groups and individuals acquire a set of values and feelings of concern for the environment and motivation for active participation in environmental improvement and protection.
4. SKILLS - to help social groups and individuals acquire skills for identifying and solving environmental problems [and/or issues]
5. PARTICIPATION - to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems [and/or issues] (Hungerford and Volk, 1990)

More specifically, the definition of marine and aquatic education is:

“...that part of the total educational process which enables people to develop a sensitivity to and a general understanding of the role of the seas and fresh water in human affairs and the impact of society on the marine and aquatic environments”

(Goodwin and Schaadt, 1977 as cited in Fortner 1991:303).

Environmental education was developed primarily from progressive and reconstructionist schools of thought, where reflective thinking fosters social problem-solving and good citizenship participation. Problem solving skills are learned through scientifically focused studies and applied to amending social concerns (J. Youatt personal communication, June 19, 1995).

The superordinate goal of EE is consistent with reconstructionist views, in which the mission of education is change through social action. In the reconstructionist philosophy, subject matter is integrated into issue-centered problems, and participation of learners is encouraged in determining solutions. Brody supports these same views as they relate to EE when he states that, “the integration of basic science concepts and skills with real life concerns... is critical to help maintain the ecology and quality of life” (Brody, 1995:18). It should be noted that knowledge and a keen mind, in addition to skills and participation, are necessary to fulfill reconstructionist convictions in which education fosters change through social action. Further discussion of GLEP’s written curriculum and program design can be found in Appendix B.

Theories of Behavior Change

Researchers maintain that “the ‘gateway’ to the learning process is the affective domain” and that possessing environmental knowledge alone will not ensure one will be motivated to take action or change behavior patterns (Iozzi, 1989:3). The traditional

linear model of behavior changes caused by changes in knowledge or awareness is no longer valid within the environmental education community (Borden and Scheltiro, 1979; Brody and Koch, 1989; Dwyer et al., 1993; Gigliotti, 1992; Gray et al., 1985; Hungerford and Volk, 1990; Marcinkowski, 1989; Sia et al., 1985/86; Sivek, 1989).

This does not mean that the cognitive domain has no relevance in the field of environmental education. On the contrary, knowledge is one of the basic stepping stones towards responsible environmental behavior. Hines, Hungerford and Tomera (1987) found that “those individuals with greater knowledge of environmental issues and/or knowledge of how to take action on those issues were more likely to have reported engaging in responsible environmental behaviors...” (Hines et al., 1987:3). Bennett (1989) refers to knowledge as the ability to recall something from memory; true understanding occurs at a higher cognitive level and involves comprehending the meaning of something and being able to explain it.

Even though the cognitive and affective domains may seem to be two separate entities, Dewey (1933) states that “intellectual force does not exist apart from the attitudes, feelings, or emotions that make us open-minded rather than close-minded, responsible rather than irresponsible” (Dewey, 1933:28-33). Knowledge alone will not result in responsible environmental behavior, and positive attitudes and action skills are useless unless correct information is guiding them. A model developed by Hines et al. (1987) provides a complete view of the process of behavior changes and incorporates several interrelated variables which ultimately result in responsible environmental behavior (Figure 1). With this model it is possible to develop, teach, and evaluate

environmental education programs which strive to develop responsible environmental behavior in learners.

The inferences in this model that must be acknowledged when developing and carrying out environmental education programs to create responsible behavior are also noted by Hines et al. and are:

- An individual who expresses an intention to take action will be more likely to engage in the action than will an individual who expresses no such intention.
- Knowledge of the issue appears to be a prerequisite to action.
- An individual must also possess knowledge of those courses of action which are available and which will be most effective in a given situation.
- Another critical component...is skill in appropriately applying this knowledge to a given issue.
- An individual must possess a desire to act. One's desire to act appears to be affected by a host of personality factors, including locus of control, attitudes toward the environment and taking action, and personal responsibility.
- Situational factors, such as economic constraints, social pressures and opportunities to choose different actions may...serve to either counteract or to strengthen the variables in the model (Hungerford and Volk, 1990:10).

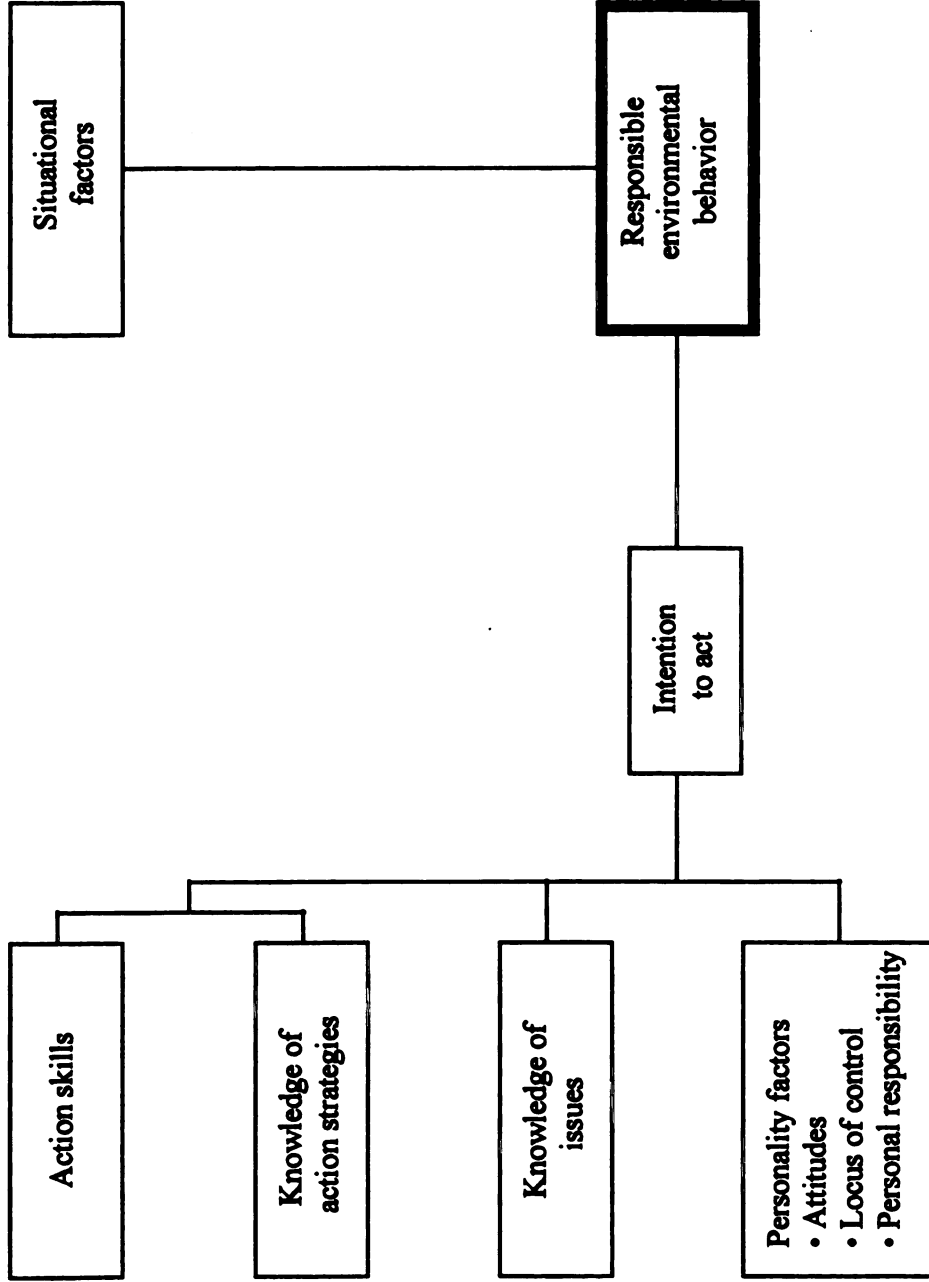


Figure 1. Model of Determinants of Responsible Environmental Behavior
(adapted from Hines et al., 1987).

These inferences need to be considered when developing and implementing environmental education curricula and programs; for example, it is erroneous to assume that skills evolve naturally from knowledge (Hines et al., 1987). Each element also needs to be handled according to its own situational factors.

Relationship Between Cognitive and Affective Domains in Designing EE Programs

Desired outcomes in environmental education include changes in knowledge, attitudes, value orientations, and behavior. Evaluators of various programs have met with difficulties in measuring these changes in the cognitive and affective domains and in behavior (Iozzi, 1989). It should be noted more studies have evaluated outcomes in the affective domain than in the cognitive domain; in addition “environmental researchers recognized quite early that focusing on the affective domain was extremely important if programs in environmental education were to be effective in teaching positive environmental attitudes and knowledge” (Iozzi, 1989:4).

Even though most of the research has been done on the affective domain, there is still very little concrete evidence that environmental education is accomplishing its objectives. Bennett (1989) states that “measuring attitudes and values is the most difficult task in evaluation because they cannot be measured directly” (Bennett, 1989:16); this may explain why most studies in the affective domain are qualitative rather than quantitative.

EE Program Evaluation And Related Research

Even though program evaluation is essential in the overall educational process, it is often not considered at all or as strongly as necessary in program planning. Some vessel-based programs have been running for over 20 years, yet no rigorous evaluations have been done. Program planners often overlook evaluation due to several factors and do not consider the innate value of evaluation. Even if evaluation is considered, it is all too often devoted to identifying reactions which reflect participants' degree of interest, acceptance of activity leaders, and attraction to educational methods of program activities. If program evaluation is to be useful in improving new and existing programs, it must be conducted in a thorough manner by examining more than participant reactions to programs. Program goals, objectives, impacts, and accomplishments must be assessed (Bennett, 1989; Boyle, 1981; Cookson, 1996; Flor, 1991).

Needs for EE Program Evaluation

Quite often program planners overlook evaluation because they have few opportunities to upgrade their competence in this area, the demands on programmers to conduct evaluation are usually minimal, there are few professional evaluators, or there is no time or money to conduct an evaluation (Stufflebeam, 1975). Sometimes, when evaluations are conducted, they only identify participant reactions which result in limited information such as whether the participants liked the program and why. Although this information is useful, it does not provide concrete evidence as to program impacts, outcomes, or accomplishments. Evaluations of participant reactions also do not provide

the information necessary to assess organizational operations or program processes. In-depth evaluations are extremely important in that they can provide concrete evidence of program achievements and shortcomings and detailed information for the improvement and development of programs.

The information collected through in-depth evaluations is essential for several reasons. Principle purposes of evaluation include: 1) improvement of organizational operation and administration (personnel, facilities, and finances), and 2) improvement of program objectives, methods, and materials (Knowles, 1980). A secondary purpose of evaluation is to provide the program's defense against attack, justification for expansion, and support for the status quo. Additional reasons for evaluation are that it affords feeling of accomplishment, helps focus goals, and can be a learning opportunity (Boyle, 1981).

The issue of program evaluation is especially evident in the field of environmental education. It has been noted in numerous articles that the lack of in-depth evaluation hinders the credibility of EE proponents and programs (Iozzi 1989; Keen, 1991; Lewis 1981/82; Linke 1981; Lucko, Disinger, and Roth 1982). Especially in experiential education programs,

“...detailed information related to the achievement of cognitive and noncognitive objectives is needed to justify programs and assure that students are prepared to deal with the numerous conservation, pollution control, energy, reclamation, and other environmental issues” (Lucko et al., 1982:11).

Evaluation Models for Environmental Education

Models that have been developed to evaluate EE programs attempt to assess outcomes related to program goals and objectives. One such model is a program evaluation

by Dr. Dean Bennett which is

“...organized around four steps: step one - deciding what to evaluate, developing objectives, and allowing for intuitive and unanticipated outcomes; step two - determining the evaluation design and developing instruments; step three - collecting, analyzing, and interpreting data; and step four - reporting results and improving the educational program” (Bennett, 1989:14).

A model similar to this is presented in the handbook produced by the Colorado State Department of Education, *Environmental Education Needs Assessment and Evaluation Manual*. This manual describes five major steps which are necessary in conducting an evaluation: 1) develop an evaluation design, 2) select and/or develop instruments, 3) collect appropriate information, 4) analyze information, and 5) prepare and present reports (Lucko et al., 1982). Each of these major steps contains several important activities which are essential in completing a thorough evaluation.

Targeting Outcomes of Programs (TOP) Evaluation Model

The Targeting Outcomes of Programs (TOP) model was developed by Drs. Claude Bennett and Kay Rockwell as an integrated approach to program planning and evaluation. The TOP model presents a simplified approach to the entire process of developing, implementing, and evaluating programs, more specifically, agricultural extension programs.

The overall model provides complete “steps” to follow for program development and performance evaluation. Program development begins with needs and opportunity assessments and proceeds toward program design (Figure 2). Evaluation of program

PROGRAM DEVELOPMENT

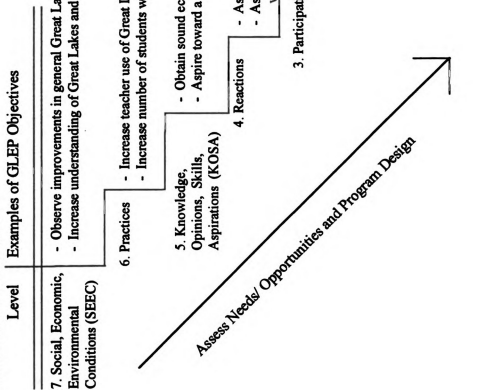


Figure 2. The TOP Model of Program Development as Applied to GLEP (adapted from S. Stewart personal communication, June 20, 1996).

performance (Figure 3) begins with process evaluation and can involve the more difficult steps of outcome evaluation. Process evaluations assess the extent that objectives for program resources, activities, participation, and participant reactions are reached. Program impact evaluations suggest the extent of program influence on knowledge, attitudes, and behavior.

The evaluation of program performance is strengthened if both process and impact evaluation can be conducted (Figure 3). Measuring objectives and target indicators at several different levels provides a check system which best measures how well a program is proceeding toward its ultimate goals. Evaluations of reactions of participants are useful in process evaluations by measuring degree of interest, acceptance of leaders, and attraction to activity methods. Evaluations of reactions provide little or no evidence of program impact. Evaluations of changes in knowledge, opinions, skills, and aspirations (KOSA) allow assessment of ultimate program impacts anticipated in the goals and objectives developed during the needs assessment phase of program.

When the TOP model is applied to GLEP, some program development and evaluation steps were clearly followed by local, Extension GLEP designers, while others were not; this makes measurement of specific GLEP performance difficult (Figure 2). GLEP developers considered target audience needs and opportunities for the social, economic, and environmental conditions (SEEC), practices, and KOSA levels, but did not record desired impacts in the form of specific, measurable goals and objectives (Figure 2). The assessment of needs and opportunities for GLEP's design did involve adequate consideration of the reactions, participation, activities, and resources steps (Figure 2).

PROGRAM PERFORMANCE EVALUATION

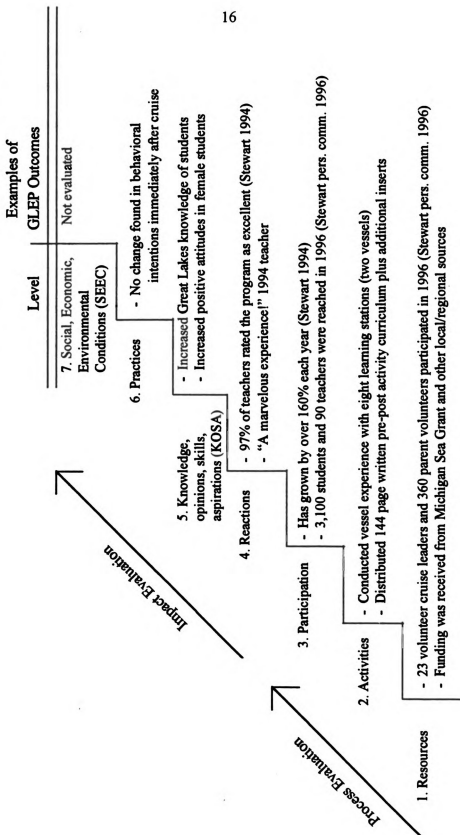


Figure 3. The TOP Model of Program Evaluation as Applied to GLEP.

Program performance in Figure 3 shows GLEP's process evaluation of the resources, activities, participation, and reactions levels as very complete and thorough. Evaluations of reactions show that both students and teachers have extremely positive attitudes toward the program, participation is multiplying, and resources are expanding (Figure 3) (Stewart, 1995). Further assessment of program performance through impact evaluations gets more difficult. Assessment at the KOSA level is the next evaluation step, but early in this project GLEP researchers found work difficult because there were no specific objectives which could be measured easily.

Careful program planning not only helps to focus goals and objectives, but it greatly facilitates program evaluation. Thorough consideration at each program developmental step can also include plans for future assessment, making evaluation more efficient and perhaps cost-effective.

Bennett's TOP model for program planning and evaluation is an excellent resource for new as well as existing programs. It is thorough in identifying program development and evaluation requirements, and it can aid planners and educators as they take into consideration all the components that are needed for a successful program.

Previous Research and Evaluation of MA/E and Experiential EE Programs

Major research in marine, aquatic, and Great Lakes environmental education has been done by Dr. Rosanne Fortner at The Ohio State University. The research has been quantitative in nature and focuses on knowledge and attitudes. A baseline study done in 1980 showed that tenth grade students had a low level of marine knowledge. Follow-up

studies on the ocean and Great Lakes demonstrated only slight and slow increases in knowledge indicating little progress had been made by other statewide educational efforts (Fortner, 1993). The evaluation instrument used in 1979 was the original Survey of Oceanic Attitudes and Knowledge (SOAK).

The only in-depth study in aquatic environmental education to date has been done by Fortner through a summative evaluation of the Oceanic Education Activities for Great Lakes Schools (OEAGLS) program (Mayer and Fortner, 1993). The first study was the baseline study in 1979. Highly knowledgeable students had more positive attitudes about the oceans and Great Lakes than did those with lower knowledge, and very interestingly, students indicated that most of their information was obtained through movies and television (Fortner and Teates, 1980). The study was repeated in 1983 and 1987 with the SOAK questionnaire modified to include a "media source" component and OEAGLS-specific information. Again, positive attitudes were directly related to higher knowledge scores, but this time the primary information source was no longer movies and television but classes in school (such as OEAGLS) (Mayer and Fortner, 1993).

Other major research in marine education and ecological misconceptions has been done by Dr. Michael J. Brody. His assessments of 4th-, 8th-, and 11th- Grade students' knowledge related to marine science and natural resource issues has shown that students seldom see the multiple connections that new concepts have to the real world, and they are unable to apply higher order ideas to daily occurrences in their lives (Brody, 1989; Brody, 1995). Methods of evaluation included the use of concept maps representing a variety of major content principles in conjunction with student interviews. A common

misconception, among others, held by half of the students interviewed is that coral reefs exist throughout the ocean. Brody explains that “when we move toward an interdisciplinary approach, such as environmental science, we increase the possibilities for misconceptions because of the multiple relationships of various concepts for the disciplines” (Brody, 1995:27). Students must learn that humans are a part of the “real world”.

Except for some of the research done by Brody, few evaluations have been fourth grade specific, and none are related to marine or aquatic resources. One fourth grade study examined the relationship among cognitive learning, field trips, and follow-up activities related to a public garden. The emphasis of the research was to evaluate the effectiveness of follow-up activities as part of the field trip experience. A pre-post test control group design was used with the fourth grade groups that participated in the field trip activity; only the experimental group received the follow-up activity instruction. Results showed “significant differences were detected between some post-test scores and between all pre-test and post-test scores suggesting that the related follow-up activities reinforced some of the concepts presented during the field trip” (Farmer and Wott, 1995:33). Possible limitations of this research are a small sample size (only 111 student subjects), an evaluation instrument consisting of only 11 questions, and lack of a control in the study design for testing effects.

Another fourth grade study evaluated conservation education programs at a South American zoo. This research proved to be quite extensive, assessing responses from 1,015 students and using a pre- post-treatment questionnaire comprised of 18 multiple

choice knowledge questions and a 16-statement, five point attitude scale. The research design consisted of four different treatment groups which included an intensive zoo workshop for elementary teachers, a zoo visit preceded by a slide show, an unstructured visit to the zoo, and a control group which received no zoo-related instruction or visit. Results showed that knowledge and attitude scores of students whose teachers participated in the education program improved significantly, but no effects on student knowledge or attitude scores were found for any other treatments (Gutierrez de White and Jacobson, 1994).

The distinct lack of well performed studies at the fourth and lower grade levels is attributed to the difficulties of measurements of knowledge and attitudes at younger ages. Lower knowledge and reading levels, shorter attention spans, and less well-developed motor skills in young children make test-taking and test-administering more challenging than with older youth. Researchers have made several modifications on survey instruments so that the younger children could more easily read and answer the questions (Wong-Leonard, 1992). Leeming, Dwyer, and Bracken (1995) repeatedly found “older children evidencing a more consistent response pattern than younger children” (Leeming et al., 1995:26).

The number of evaluations of experiential education at other grade levels is also insufficient. In a critical review of outcome research focusing on school children, only 17 published studies since 1974 have evaluated interventions emphasizing activities primarily outside of a normal classroom setting (Leeming et al., 1993). Three of these studies were at the fifth grade level, and none were at the fourth grade level.

No review is ever perfect, and only a few more evaluations of programs were found besides those in the review. They include assessments of various experiential programs such as a seven day, high school, ecological, field study (Lisowski and Disinger, 1991), the Sunship Earth Program which is a five day camp for fifth and sixth graders (Keen, 1991), and a two week preteen summer nature camp (Dresner and Gill, 1994).

Many evaluations of in-classroom EE instruction are also available (Charles, 1988; Race, Decker, and Taylor, 1990) including 17 more found in the 1993 critical review by Leeming et al. Other research which is not program specific in its evaluation assesses the existing levels of students' knowledge and attitudes toward various environmental topics (Walter and Lien, 1985; Kellert, 1985).

Limitations of Previous Research

Previous research has been limited by several factors which can be either controllable or uncontrollable. Especially problematic in evaluation is the measurement of attitudes, values, and behavior because they cannot be measured directly. Hines, Hungerford, and Tomera also state that "it has long been known that the prediction of behavior is an extremely complex process which is based on a multitude of factors" (Hines et al., 1987:8). In addition to the problem of measuring attitudes and behaviors, environmental education is by its nature interdisciplinary, which makes efforts to determine the degrees of effectiveness even more difficult (Lucko et al., 1982).

The critical review of 34 EE evaluations by Leeming et al. revealed several

controllable factors which critically limited many of the assessments (Leeming et al., 1993). The most common and serious error of analysis found was concerned with the unit of analysis, which should be the classroom and not the individual student if the original sampling unit was the classroom; “individuals in a class or other intact group clearly do not constitute independent measures, and their responses may be affected by numerous confounding factors other than or in addition to any true treatment effect” (Leeming et al., 1993:18). Another problem involves the measurement instrument. The instrument used should be reliable and valid, and preferably constructed from existing inventories. The experimenter or the same person who presented the intervention should not administer the instrument, in order to avoid any experimenter expectancies or bias. Experimental designs must be carefully planned and include control groups. Appropriate statistical techniques must be applied in checking for testing effects and in determining treatment effects. Lastly, “...few investigators collect follow-up data to determine whether observed effects persist over time” (Leeming et al., 1993:18).

Research Questions

The focus of this quasi-experimental research is to quantitatively measure the impacts of the GLEP vessel experience on students’ changes in Great Lakes knowledge, attitudes towards the Great Lakes, and responsible behavioral intentions regarding the Great Lakes. Specific research questions about the vessel experience include the following:

1. Knowledge:
 - a. Does the one day GLEP vessel experience increase student knowledge of the Great Lakes?
2. Attitudes and intentions:
 - a. Have student attitudes regarding the Great Lakes changed after the one day GLEP vessel experience?
 - b. Is there a change in responsible behavioral intentions regarding the Great Lakes after the one day GLEP vessel experience?

In order to address these questions, a valid and reliable measurement instrument must first be developed, and then research methodology will be carefully considered. Answers to the research questions will be used to make recommendations to strengthen GLEP and similar marine and aquatic education and experiential environmental education programs. If program weaknesses are identified, suggestions for improvement will be made as necessary. Likewise, if the GLEP evaluation itself has limitations, they will be identified and suggestions and recommendations for future research will be made.

Chapter 3

METHODS

Development of Evaluation Instrument

To measure “concrete” program results, several researchers have developed evaluation instruments. One general instrument is the Children’s Environmental Attitude and Knowledge Scale (CHEAKS) developed by Leeming, Dwyer, and Bracken (1995). The CHEAKS ecological attitude and knowledge scales include items that relate to major attitudinal constructs, including environmental commitment, behavior, and affect. Since the CHEAKS was designed for use with a wide range of age (grades 1-7) and ability levels, reliability and validity were somewhat sacrificed. While attitudinal subscales had high reliability and validity, knowledge subscales did not, possibly because of younger children’s lower knowledge levels or reading skills (Leeming et al., 1995).

Other evaluation instruments available are less general and are more program-specific. Seven different surveys/questionnaires have been developed for specific environmental programs or research evaluations. These instruments include: 1) Coral Reef Classroom Student Survey (Kelly, 1995), 2) Inland Seas Education Association Student Post Trip Evaluation (Schulz, 1994), 3) Wildlife Education Survey - 4th Grade (Gilcrest, 1989/90), 4) Marine Education Knowledge Inventory (Hounshell and Hampton,

1982), 5) Children's Wildlife Perception Survey (Wong-Leonard, 1992), 6) Water and Aquatic Life (Stout et al., 1989), and 7) Survey of Oceanic Attitudes and Knowledge (SOAK) (Fortner and Mayer, 1983). Only the Children's Wildlife Perception Survey and SOAK instruments have been tested for reliability and validity, while others have not been scrutinized at all.

The GLEP evaluation instrument was developed primarily from these pre-existing instruments. Survey items from the instruments were pooled into a large database. Before attempting to assess student knowledge in any domain, the major concepts and organizing principles of the knowledge domain should be identified (Champagne and Klopfer, 1984 as cited in Brody and Koch, 1989). Great Lakes Education Program objectives were matched to fourth grade level standards and benchmarks from *Michigan's Essential Goals and Objectives for Science Education (K-12)* (1991) and *Michigan Core Curriculum Content and Standards* (1994). In an attempt to assure content validity of the GLEP instrument, knowledge questions from the item pool were matched to GLEP objectives and the benchmarks, and some questions were edited as necessary to be GLEP specific. Experience, attitude, and behavioral intention questions were also selected from the item pool and edited to fit GLEP.

The measurement model consisted of three scales and an experience section. The scale measuring attitudes toward the Great Lakes was composed of semantic differential items with adjective pairs and a scale ranging from 1-5. I measured students' behavioral intentions using a 3-point Likert scale with possible responses of true, maybe, or false. The knowledge scale consisted of multiple choice questions. I measured students' past

experiences by asking questions with yes, no, or maybe answers. Nine experts in the field of EE reviewed the instrument. Reviewers included aquatic educators, agency personnel, and university faculty in natural resource and family and child ecology departments. Two fourth grade children also helped with the review, and suggested revisions were made.

Pilot Study

Before executing a full scale evaluation, we conducted a pilot study to test the evaluation instrument and to determine an appropriate experimental design and sample sizes. Twenty classrooms of fourth grade students who participated in GLEP during the fall 1995 cruise season were post-tested, and two more classrooms were pre- and post-tested.

After I completed the pilot data collection, I used version 6.1.11 of the Statistical Package for Social Sciences (SPSS) software to calculate scale reliabilities (Norusis, 1993). The software enabled me to test the attitude and behavioral intentions scales with Chronbach's Alpha, the knowledge scale with Kuder and Richardson's KR20 formula, and the experience section with test-retest reliability (correlation coefficient).

Chronbach's Alpha and the KR20 formulas are essentially the same, except that Chronbach's Alpha is used when multiple responses are involved, and the KR20 is used for dichotomous answers. Items which brought the scales below a 0.60 reliability were dropped. Other modifications to the evaluation instrument included the addition of a boating question to the experience section because it directly related to outdoor aquatic natural resource contact. Minor alterations to the wording of items in all sections were

performed for clarification or emphasis. The reliabilities of the final pilot scales were all above 0.61 (Table 1). The final instrument can be seen in Appendix C.

Final Instrument Reliabilities

Reliabilities of the final instrument scales were all higher than the pilot scale reliabilities (Table 1). The lowest reliabilities in the final instrument were in the experimental group's pre-test scales. The highest reliabilities were found in the experimental group's post-test scales, and the control group had reliabilities between the pre- and post-test groups (Table 1). The reliability of the attitude scale (pre-test data) was probably the lowest because the children who took the pre-test were the least familiar with the survey and the cruise. The control group was familiar with the cruise but not the survey, and the attitude scale reliability for this group was slightly higher at 0.68. The post-test group was the most familiar with both the survey and the cruise, and, as a result, the attitude scale reliability was the highest (0.76). The reliability estimates for behavioral intention and knowledge scales follow a similar pattern.

The GLEP instrument scale reliabilities can be compared to the reliabilities of other instrument scales (Table 1). Cynthia Wong-Leonard surveyed students in grades 1-3 and 6-8. Her "Moral Attributes" scale had reliabilities of 0.54 and 0.70, and the "Physical Attributes" scale had reliabilities of 0.79 and 0.87 (Wong-Leonard, 1992). It should be noted that, in Table 1, Wong-Leonard's "Moral Attributes" scale is listed under the Attitude Scale column because it contained items asking about student attitudes. The "Physical Attributes" scale is listed under the Knowledge Scale column

Table 1. Scale Reliabilities for Pilot Survey, Full Evaluation Study, and Comparable Research.

Instrument	Chronbach's Alpha		KR-20
	Attitude Scale (n)	Behavioral Intention Scale (n)	Knowledge Scale (n)
GLEP Pilot Post-Only test	.61 (270)	.75 (270)	.61 (270)
GLEP Experimental Pre-test	.63 (494)	.81 (494)	.65 (494)
GLEP Experimental Post-test	.76 (494)	.86 (494)	.70 (494)
GLEP Control Post-Only test	.68 (451)	.81 (451)	.68 (451)
Wong-Leonard¹			
Grades 1-3	.54 (838)	---	.79 (838)
Grades 6-8	.70 (1362)	---	.87 (1362)
CHEAKS²			
Grades 1-3	---	.888 (324)	.652 (324)
Grades 4-7	---	.914 (920)	.762 (917)
Modified SOAK³			
Grade 5	NA	---	.38-.51 (NA)
Grade 9	NA	---	.56-.72 (NA)

Wong-Leonard¹ = Wong-Leonard's instrument contained a "Moral Attributes" or Attitude scale and a "Physical Attributes" or Knowledge scale.

CHEAKS² = The CHEAKS Behavioral Intention scale was originally labeled an Attitude scale by its authors.

Modified SOAK³ = Fortner's Great Lakes specific instrument; attitude scale reliability not available.

because it asked questions which relate to knowledge of wildlife's physical attributes.

The Children's Environmental Attitude and Knowledge Scale (CHEAKS) had an "Attitude Scale" reliability of 0.91 for students in grades 4-7 (Table 1). This "Attitude Scale" reliability is listed under the Behavioral Intention Scale in Table 1 because the CHEAKS questions pertained more to actions than opinions. Thus, I chose to use these CHEAKS items as the basis for measuring behavioral intentions of students.

Knowledge scale reliabilities for Rosanne Fortner's Great Lakes modified Survey of Oceanic Attitudes and Knowledge (SOAK) were low for fifth grade students (0.38-0.51) but were slightly higher for students in grade nine (0.56-0.72) (Table 1).

Reliabilities for Fortner's attitude scale are not available in the literature.

The final experience scale had a test-retest reliability of 0.84 (Table 2). The final scale consisted of ten experience questions including a new boating question for the spring, and not including four problematic items which were still in the spring scale (Appendix D, Table D-4).

Two problematic experience questions asked students whether they had "visited the Great Lakes or Lake St. Clair" or "participated in classroom activities about water, the oceans, or the Great Lakes." These variables had low test-retest reliabilities and displayed significant differences between pre- and post-tests (Table 2). Problems with these two items may be attributed to the cruise experience itself, even though an attempt was made on the spring survey to change the wording of questions to include "before your cruise."

The variable "Have you tried to learn how to swim?" was dropped from the scale

because of low test-retest correlations on both the pilot and spring surveys. Clarifying the question for the spring survey did not improve the test-retest reliability (Table 2). The last experience item dropped was “Have you watched nature programs on TV about water, the oceans, or the Great Lakes?,” because of low reliability and a significant difference between pre- and post-test answers (Table 2).

Table 2. Experience Variables Excluded from Final Experience Scale Analysis.

Excluded Experience Variable	Pilot Correlation	Spring Correlation	Spring Sig.
visited the Great Lakes or Lake St. Clair?	.21	.62	<.001**
learn how to swim?	.38	.48	.564
done classroom aquatic activities?	.33	.29	.005*
watched aquatic nature programs on TV?	.55	.67	.030*
Final Scale¹	—	.844	.143

Final Scale¹ = All experience variables in Appendix D, Table D-4 minus the four variables listed in the above table (visited the Great Lakes or Lake St. Clair?, learn how to swim? done classroom aquatic activities? watched aquatic nature programs on TV?).

Readability of Instrument

Readability of the final instrument was measured by several different scales and adequately represents a fourth grade reading level. Analysis with the Flesch-Kincaid

Grade Level Test showed a 5.68 reading level using WordPerfect software, and a 2.0 grade level using Microsoft Word software; an average of the two tests yields a 3.84 grade readability level. Another readability calculation is the Fog Index which yielded a 3.53 grade level (Miles 1989, Vol. 11, No.2). It should also be taken into consideration that the survey was read aloud, and children's "listening" or oral comprehension of text is approximately two years higher than their understanding of written material (Sticht and James, 1984 as cited in Wong-Leonard, 1992:96).

Final Evaluation Protocol

The Michigan State University Committee on Research Involving Human Subjects approved all research methodology (Appendix A). Teachers were given a packet containing a cover letter, 30 evaluation permission slips, and a GLEP evaluation brochure when they attended the first mandatory GLEP teacher training session in February of 1996 (Appendix E). Several weeks before the GLEP vessel experience, the teachers distributed the permission slips to the students who returned them signed by their parents/guardians. Collected classroom permission slips either were mailed in with the final GLEP payment or collected on the day of the surveys. One week before the field trip, a survey reader contacted the teacher to set up appointment times to conduct the pre/post surveys or the post-only surveys. The day before the students' trip, the survey reader visited the classrooms and read the surveys aloud, while the students followed along and answered the questions. On the day after the cruise, the same survey reader visited the classrooms again and read the same survey aloud. Schools taking cruises on

Fridays were given post-tests on Mondays. There were no Monday cruises, so pre-tests were never given on Fridays. The participating teachers also filled out a post-cruise evaluation. After the surveys were completed, researchers gave teachers a token of appreciation in the form of a thank you letter and five different habitat posters (Appendix E).

Experimental Design

The method used for the evaluation was a separate-sample, pre- post-test design (Campbell and Stanley, 1963). This approach was chosen since “evaluation using a quasi-experimental design is far more valuable because it attempts to control variables so that discernable change can be attributed to the education program” (Matthews and Riley, 1995:45). The separate-sample, pre- post-test design was selected because of its control over external threats to validity such as testing effect. It was also very compatible with GLEP and research circumstances. A non-treatment design was not selected because of difficulties in obtaining non-participating classrooms and lack of control over testing effect. Threats to internal validity in this design were not considered to be high risk and were easily managed. Maturation (the passage of time) and history (specific events occurring between measurements) were controlled for by administering the surveys on the days immediately before and after the treatment, except when weekends were involved. Experimenter bias was controlled by thoroughly training the survey reader and by not involving this person in any part of the education program. Two study groups were created to control for the main effect of testing and to measure the effects of the treatment

on students (Table 3).

Table 3. Study Design.

Study Group	# of Original Classrooms	# of Non-useable Classrooms¹	Final # of Classrooms
Experimental (Pre & Post Surveys)	28	9	19
Control (Post-Only Survey)	33	13	20
Totals	61	22	39

of Non-useable Classrooms¹ = Classrooms not meeting research criteria because of teacher non-participation(6), gifted classrooms(1), split classrooms(4), private classrooms(6), or levels other than fourth grade(5).

Final Testing Procedure

Through standard sample size formulas, the number of classrooms required for each of the study groups was determined (Sokal and Rohlf, 1995:263). The formulas incorporated the averages and variances of the pilot measurement scales. Sample size (n) was determined for alpha=0.05, power=80%, and a detectable difference of 20% of the mean. Calculations showed that no less than 15 classrooms were needed per study group. To insure that at least 15 viable classrooms were in each of the final study groups, all 61 classrooms were included in the original study design (Table 3).

All classrooms were equally and randomly assigned to either a pre- and post-test

treatment or a post-test only control group using a table of random digits (Neter, Wasserman, and Whitmore, 1993:936). Since GLEP targets students at the fourth grade level, the evaluation focused on fourth grade students in the public school system. The use of all the classrooms in the evaluation was fortunately a good decision, since 22 of the original classrooms did not fit the evaluation criteria for various reasons including teacher non-participation, gifted classrooms, multi-grade classrooms, private classrooms, and levels other than fourth grade. The final number of classrooms in the experimental treatment group was 19, and the number in the control group was 20 (Table 3).

Data Analysis

A research intern entered data into a SPSS spreadsheet. After all the surveys were entered, data entry accuracy was examined by determining the frequency of keystroke error. Eighty-eight, or 5%, of the 1,821 surveys were re-entered to check for mistakes. There were three errors in 5,456 total keystrokes, resulting in a .0005 error rate. Since this probability of keystroke error was so low it was determined unnecessary to re-key all the surveys.

Summary statistics, scale scores, t-tests, non-parametric, and final instrument reliability statistics were performed using the same SPSS software.

Chapter 4

RESULTS

Response Rates

Final response rates to the GLEP evaluation were quite satisfactory. A total of 1,133 eligible fourth graders were students in classrooms participating in the evaluation (Table 4). The overall response rate for these students was 83% (Table 4). Reasons for unusable cases included denied or missing parental permission, students' absence on the day of the survey, or missing pre- or post-tests.

Table 4. Response Rates.

Study Group	# Eligible Students	% Students with Permission	% Students with Permission and Survey	% Usable Surveys ¹	Final # Usable Cases	% Overall Response Rate
Experimental	571	98	96	90	494	87
Control	562	86	80	100	451	80
Totals	1133	92	88	95	945	83

% Usable Surveys¹ = Both Pre- and Post-surveys were completed.

Scale Score Frequency Distributions and Means

The mean classroom scores for the experimental groups pre- post-surveys, and the control groups post-only surveys were all above the center, or neutral point, and some scale distributions were highly skewed left. Classroom means for the attitude scale (max. 40 points) showed very positive attitudes toward the Great Lakes with pre- and both post-test scores above a mean score of 34.0 points (neutral attitudes would have total score of 24 points) (Figure 4). Initial behavioral intentions were high with a mean of 32.6 points out 39 total, and post-cruise average intentions remained high at 32.0 points or above (neutral behavioral intentions would have a total score of 26 points) (Figure 5). In Figure 6, mean knowledge scores for pre-tests (13.7) were slightly above the neutral point of 11, and post-test and post-only test scores increased to above classroom means of 15.5 points. Experience scores were only slightly above the neutral scale score of 5 points with average totals between 6.0-6.23 points (Figure 7). Additional information on distributions of individual student responses to particular survey items can be found in Appendix D, Tables D1-D4.

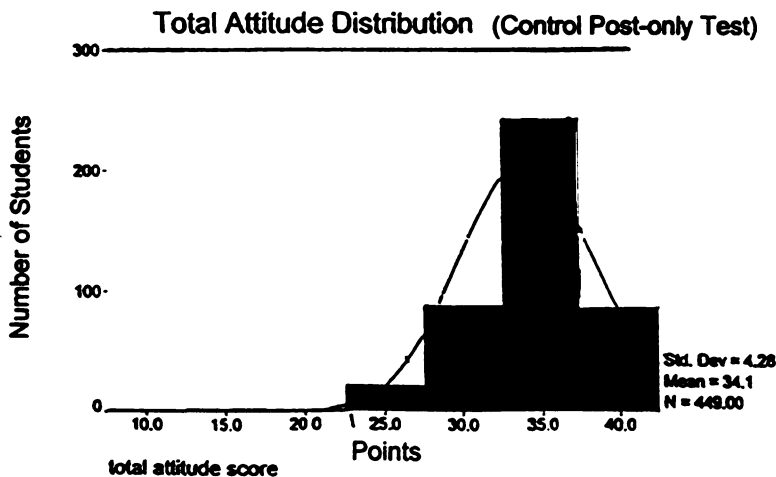
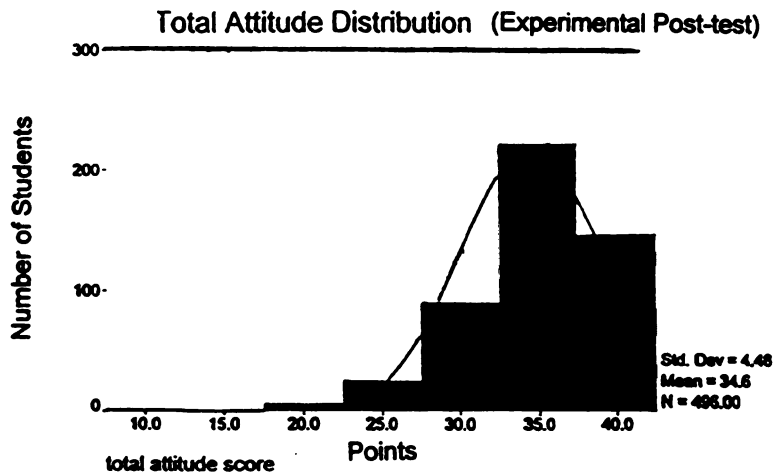
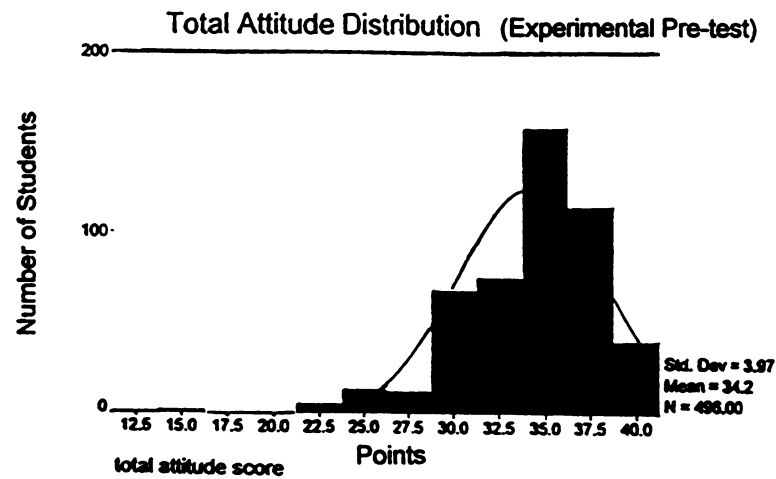


Figure 4. Total Attitude Distribution for Experimental and Control Groups.

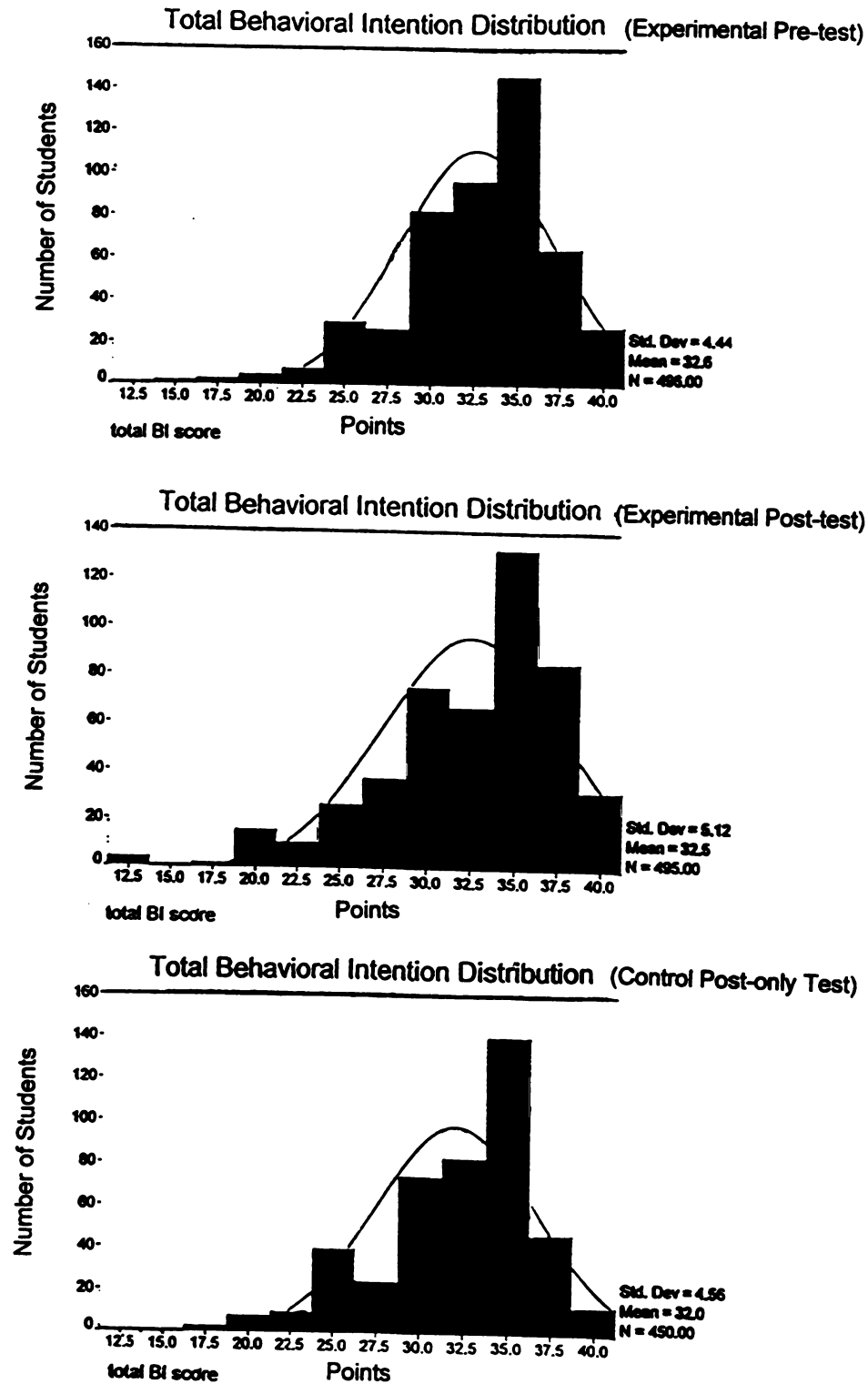


Figure 5. Total Behavioral Intention Distribution for Experimental and Control Groups.

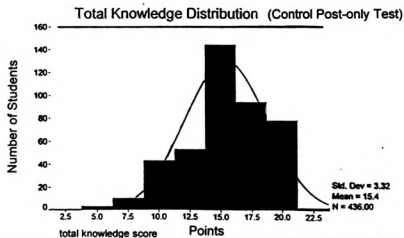
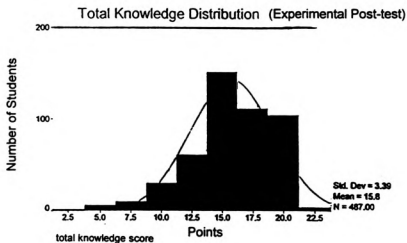
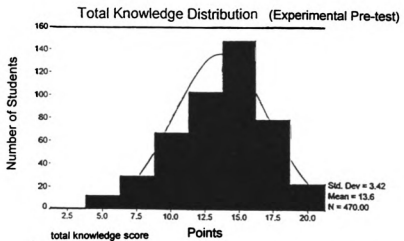


Figure 6. Total Knowledge Distribution for Experimental and Control Groups.

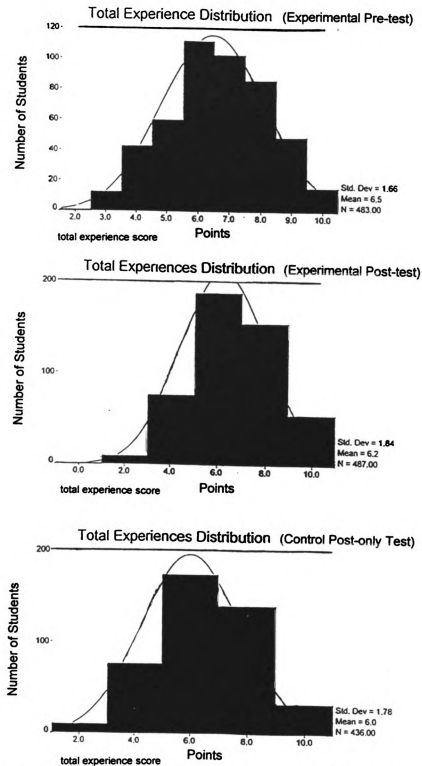


Figure 7. Total Experience Distribution for Experimental and Control Groups.

Potential Testing Effect - Experimental vs. Control Groups

By comparing the post-test scores of the experimental and control groups, a testing effect, if present, can be identified. Since the data in some of the scales were highly skewed and/or non-normal, the nonparametric Mann-Whitney U test was performed to compare control vs. experimental classroom medians (Table 5). No significant differences were found between the experimental and control groups, with Mann-Whitney U p-values ranging from .082-.369 (Table 5). These results indicate that there was no testing effect present at the classroom level between the experimental and control groups.

Table 5. Evaluation of Potential Testing Effect; Mann-Whitney U Nonparametric Tests on Control vs. Experimental Group Classroom Medians.

Scale (Max. Score)	Survey ¹	Median	Sum of Ranks	# of Classrooms	2-tailed p
Attitude (40)	Pst.	23.3	442.0	19	.082
	PO	16.9	338.0	20	
Behavioral Intention (39)	Pst.	17.7	427.0	19	.187
	PO	22.5	353.0	20	
Knowledge (22)	Pst.	22.3	423.0	19	.227
	PO	17.9	357.0	20	
Experience (10)	Pst.	21.7	412.0	19	.369
	PO	18.4	368.0	20	

Survey¹ = Pst. = Experimental Group Post-test survey
 PO = Control Group Post-Only survey

GLEP Cruise Effects on Attitudes, Behavioral Intentions, and Knowledge

By comparing the experimental group's pre-test scores to post-test scores we were able to determine whether there was a treatment effect of the cruise on students' attitudes, knowledge, and behavioral intentions. Differences in classroom mean scores for each scale were calculated and then compared using a paired t-test.

In general, there was an overall treatment effect of the cruise on student knowledge (Table 6). For pre- vs. post-test scale scores, there was a 2.26 point mean increase in the number of correct knowledge questions answered. This increase is highly significant with a 2-tailed significance of less than .001 (Table 6). There were no significant changes observed in overall attitudes, behavioral intentions, or experiences as a result of the cruise (Table 6).

Table 6. Paired t-tests on Classroom Scale Differences in the Experimental Group.

Scale	Mean Difference	SD	t-value	df	2-tailed sig.
Attitude	.40	.98	1.76	18	.096
Behavioral Intentions	-.11	.65	-.74	18	.470
Knowledge	2.26	.84	11.78	18	<.001**
Experience	.08	.20	1.84	18	.082

Pre-existing and Persisting Gender Differences

Further analyses of the data show significant gender differences. Unpaired t-tests of boys' vs. girls' classroom means on pre-, post-, and post-only surveys showed highly

significant differences ($p < .001$) in boys vs. girls in behavioral intentions and experiences (Table 7). Girls reported that they were more likely to perform responsible environmental behaviors, while boys consistently had significantly more outdoor and aquatic natural resource experiences. There were, however, no significant gender differences in attitudes or knowledge (Table 7).

Survey, Gender¹ = Pre,B. = Pre-test, Boys' survey. Pre,G = Pre-test, Girls' survey.
Pst,B. = Post-test, Boys' survey. Pst,G = Post-test, Girls' survey.
PO,B. = Post-Only, Boys' survey. PO,G = Post-Only, Girls' survey.
df² = Degrees of Freedom has a decimal place if Levene's Test for Equality of
Variances proved unequal.

Table 7. Unpaired T-tests of Boys' vs. Girls' Scale Totals on Pre-, Post-, and Post-Only Surveys.

Scale (Max. Score)	Survey, Gender ¹	Mean	SD	t-value	df ²	2-tailed sig.
Attitude (40)	Pre,B	34.0	1.0	-1.06	36.0	.295
	Pre,G	34.4	1.3			
	Pst,B	34.2	1.9	-1.67	36.0	.104
	Pst,G	35.0	1.2			
	PO,B	33.5	1.9	-1.80	38.0	.080
	PO,G	34.5	1.4			
Behavioral Intention (39)	Pre,B	31.7	1.6	-4.19	31.2	<.001**
	Pre,G	33.6	1.1			
	Pst,B	31.5	1.7	-4.08	36.0	<.001**
	Pst,G	33.5	1.3			
	PO,B	31.1	1.9	-3.91	38.0	<.001**
	PO,G	32.3	1.6			
Knowledge (22)	Pre,B	13.8	1.3	1.08	36.0	.286
	Pre,G	13.4	1.2			
	Pst,B	15.9	1.2	0.47	36.0	.640
	Pst,G	15.7	1.4			
	PO,B	15.6	1.4	1.31	38.0	.130
	PO,G	15.0	1.6			
Experience (10)	Pre,B	6.4	0.50	4.24	36.0	<.001**
	Pre,G	5.8	0.45			
	Pst,B	6.6	0.53	4.81	36.0	<.001**
	Pst,G	5.8	0.40			
	PO,B	6.2	0.70	2.37	38.0	.023*
	PO,G	5.7	0.60			

Inspection of individual items in the behavioral intentions scale revealed that girls responded significantly more positively than boys on 10 out of 13 items (Table 8). The only item which boys reported significantly more frequently than girls was that boys 'Get mad about the damage pollution does to the Great Lakes.' This analysis was performed with a Pearson's Chi-square test on individual student answers.

Table 8. Pearson's Chi-Square for Boys' vs. Girls' Behavioral Intentions.

Question	Test ¹	% Response ²		Sig.
		Girls'	Boys'	
mad about pollution damage?	Pre	38.1	38.9	.045*
	Pst	39.0	37.0	.045*
	PO	36.6	37.7	.012*
scared people don't care?	Pre	23.6	21.6	.030*
	Pst	25.7	21.6	.006*
	PO	20.8	20.5	<.001**
worried about env. problems?	Pre	40.1	38.7	.043*
	Pst	40.6	38.2	.014*
	PO	41.6	39.6	.170
upset when see people use too much water?	Pre	15.8	15.0	.016*
	Pst	20.4	18.4	.308
	PO	14.8	12.1	.001*
frightened of pollution effects on family?	Pre	38.2	37.4	.008*
	Pst	38.0	37.6	.026*
	PO	39.7	37.9	.030*

Table 8 (cont'd).

Question	Test ¹	% Response ²		Sig.
		Girls'	Boys'	
sad to see houses built on wetlands?	Pre	28.3	30.4	.023*
	Pst	31.0	31.0	.251
	PO	32.3	31.2	.230
willing to turn off water while brushing teeth?	Pre	43.7	41.5	.001*
	Pst	42.6	38.9	.001*
	PO	43.5	38.2	<.001**
willing to use less water when bathe?	Pre	34.5	32.1	.002*
	Pst	31.7	29.3	.140
	PO	31.0	24.7	.009*
give own \$15 to help the Great Lakes?	Pre	30.4	28.0	.035*
	Pst	31.2	23.1	<.001**
	PO	26.7	21.8	<.001**
willing to pass out Great Lakes information?	Pre	31.1	28.3	.011*
	Pst	32.0	28.7	.006
	PO	34.8	29.0	.011*
willing to write letters to help stop pollution?	Pre	33.1	26.1	<.001**
	Pst	30.2	24.5	<.001**
	PO	29.9	21.9	.001*
willing to pick up litter at Great Lakes beach?	Pre	37.1	32.9	.002*
	Pst	33.8	28.5	<.001**
	PO	34.2	29.7	.011*
interested in career related to aquatics?	Pre	14.9	13.9	.015*
	Pst	15.2	14.0	.137
	PO	10.9	12.0	.203

Test¹ = Pre = Pre-test (Experimental Group)

Pst = Post-test (Experimental Group)

PO = Post-Only test (Control Group)

% Response² = Percent response for the answer, TRUE; the higher percent is bolded when statistically different.

Conversely, Pearson's Chi-square item analysis of the experience scale showed that boys had significantly more experiences in three out of ten items (Table 9). These experiences included the following outdoor activities: fishing, fishing the Great Lakes, and snorkeling (Table 9).

Test¹ = Pre = Pre-test (Experimental Group)

Pst = Post-test (Experimental Group)

PO = Post-Only test (Control Group)

% Response² = Percent response for the answer, TRUE; the higher percent is bolded when statistically different.

Table 9. Pearson's Chi-Square for Boys' vs. Girls' Experiences.

Experience Variable	Test ¹	% Response ²		Spring Sig.
		Girls'	Boys	
have you ever gone fishing?	Pre	85.0	93.3	.004*
	Pst	84.6	92.1	.009*
	PO	83.2	88.7	.219
have you gone fishing in one of the Great Lakes?	Pre	23.5	44.7	<.001**
	Pst	28.8	52.4	<.001**
	PO	22.2	45.5	<.001**
do you have an aquarium with fish?	Pre	36.4	42.4	.176
	Pst	37.7	41.7	.355
	PO	34.3	43.5	.063
belong to 4-H, Boy Scouts, or Girl Scouts?	Pre	23.8	18.1	.123
	Pst	22.1	17.7	.224
	PO	20.0	22.1	.757
have you gone to a zoo?	Pre	99.2	98.0	.286
	Pst	99.6	97.6	.069
	PO	99.5	96.1	.049*
have you gone to an aquarium or Sea World?	Pre	79.6	79.3	.937
	Pst	80.7	79.1	.671
	PO	83.4	79.6	.516
does you family go camping?	Pre	56.9	61.3	.317
	Pst	56.9	64.6	.081
	PO	58.1	59.0	.692
ever been scuba diving or snorkeling?	Pre	22.9	41.8	<.001**
	Pst	22.0	47.2	<.001**
	PO	23.6	41.1	<.001**
read books or magazines about aquatics?	Pre	64.4	70.3	.163
	Pst	64.2	67.3	.460
	PO	56.2	58.0	.693
ever been on a motorboat, sailboat, or canoe?	Pre	90.0	94.5	.056
	Pst	88.8	93.3	.076
	PO	90.8	87.0	.412

GLEP Cruise Effects on Boys vs. Girls

In order to examine the effects of the GLEP cruise on attitudes, behavioral intentions, and knowledge of boys vs. girls, one sample t-tests were performed by gender on classroom mean scale differences. There were no significant changes in any of the tested mean differences for behavioral intentions for either boys or girls (Table 10). As shown in a previous analysis, the knowledge scale mean differences showed a highly significant increase in knowledge for both boys and girls. Additionally, girls showed a significant increase in attitudes whereas boys did not (Table 10). This finding was masked when boys' and girls' scores were pooled together.

Table 10. One Sample t-tests on Boys' vs. Girls' Classroom Scale Differences in the Experimental Group.

Scale	Gender	Mean Difference	SD	t-value	df	2-tailed sig.
Attitude	Boys	.20	1.38	.61	18	.547
	Girls	.58	.99	2.57	18	.019*
	Total	.40	.98	1.76	18	.096
Behavioral Intentions	Boys	-.19	.87	-.94	18	.359
	Girls	-.05	.81	-.26	18	.797
	Total	-.11	.65	-.74	18	.470
Knowledge	Boys	2.10	1.02	9.00	18	<.001**
	Girls	2.41	.95	11.13	18	<.001**
	Total	2.26	.84	11.78	18	<.001**
Experience	Boys	.13	.30	1.86	18	.080
	Girls	.03	.27	.49	18	.633
	Total	.08	.20	1.84	18	.082

GLEP Cruise Effects and Prior Experiences

To test for the effects of the GLEP cruise on students with low Great Lakes and aquatic natural resource experiences, analyses were performed on three (15%) and six (30%) of the classrooms with the lowest mean experience scale scores. Paired sample t-tests were performed on classroom mean scale differences in attitudes, behavioral intentions, and knowledge. Again, significant effects were observed only in the knowledge scale (Table 11).

Table 11. Paired Sample t-tests on Classroom Scale Differences in Experimental Classrooms with Low Experience Levels¹.

Scale	# of classrooms	Mean Difference	SD	t-value	df	2-tailed sig.
Attitude	3	1.2	.91	2.34	2	.144
	6	.33	1.6	.53	5	.622
Behavioral Intentions	3	.07	.75	.17	2	.881
	6	-.21	.60	-.88	5	.422
Knowledge	3	3.1	1.1	5.07	2	.037*
	6	2.52	1.0	6.17	5	.002*

Low Experience Levels¹ = classrooms with the three (15%) and six (30%) lowest experience scale scores.

Chapter 5

DISCUSSION

Experimental Design

By performing a full-scale evaluation which consisted of a separate sample, pre-post-test design, I was able to avoid many methodological problems. Since data analyses were performed at the classroom level, the probability of Type I errors (rejection of a true null hypothesis) was greatly reduced (Leeming et al., 1993). Analyses showed no significant differences between the experimental and control groups' post-cruise scores, indicating there was no testing effect present at the classroom level. Pre-test scale means were then compared to post-test means, and mean scale differences were tested.

Mean Classroom Scores

Mean measurements of attitudes, behavioral intentions, knowledge, and experiences were all above the center, or neutral point, for each scale. Initial mean measurements for the attitude and behavioral intentions scales were highly skewed left, and this may have caused problems in observing changes in these measures. High initial scores may make it difficult to detect any increases which might have otherwise occurred. This may have been the case, since 91% of participating GLEP teachers conducted pre-

cruise, Great Lakes activities (Nevala, 1996). Sensitivities of the attitude and behavioral intentions scales may not have been keen enough to detect significant changes, and maybe an attitude scale constructed of semantic differential questions would demonstrate accurate sensitivities. The experience and knowledge scales were not problematic, since initial mean measurements were not far from neutral points on the scales.

High scores for attitudes measured in this study are consistent with other, similar studies of attitudes toward the Great Lakes and aquatic natural resources. Research conducted in Ohio on students in the 5th and 9th grades showed positive attitudes toward the ocean and Lake Erie (Fortner, 1993).

GLEP Cruise Effects

This study showed that there was no significant overall increase in positive attitudes toward the Great Lakes as a result of the GLEP cruise. These results are consistent with the findings of other research, since attitudes are difficult to measure directly, and our attitude scale may not have been sensitive enough to measure changes in attitudes among students in general. It has also been speculated that the evolution of attitudes may be characterized by small positive modifications over time that eventually become recognizable as new attitudes (Fishbein and Ajzen, 1975; Fortner and Lyon, 1985 as cited in Gutierrez de White and Jacobson, 1994). Since the post-test survey was taken the day after the cruise, modifications in overall attitudes may not have been detected immediately.

Significant effects of the GLEP cruise are apparent in overall knowledge increases

in students at the classroom level. These findings are especially important at the fourth grade level since ecological foundations are a major emphasis during this developmental stage (Wilke, 1993).

Significant changes in responsible behavioral intentions were not observed in students as a direct result of the GLEP cruise. A citizenship skills activity performed on the cruise could only be finished in the days to follow due to bacterial growth limitations in the Coliform bacteria test. Since the results of the test do not appear until 2-3 days after the cruise, students must wait to determine the outcomes and then proceed with proper action strategies, such as a telephone call to the sewage plant. Unfortunately, the GLEP post-tests were given before the students could determine the results of the bacterial test. Strategies to avoid this problem of not testing a behavioral component of the cruise include conducting another activity which involves using citizenship skills immediately or waiting to perform the post survey until the completion of the Coliform bacteria activity. In either case, it is difficult to measure changes in behavioral intentions because this type of change is something that will occur gradually over time.

Even though higher knowledge levels have been related to more positive attitudes (Fortner, 1993; Gutierrez de White and Jacobson, 1994), these two constructs together, if positive, have not been proven to increase responsible environmental behavior. Strong predictors of responsible behavior require both knowledge of and skill in using environmental action strategies (Sia et al., 1985/86). In order to get students to change their behavior, critical thinking and interpersonal skills must be learned, and practiced by the students. Furthermore, in an education program, "The message *must* be specific about

what behavior is expected if behavioral change is to occur” (Matthews and Riley, 1995:29).

Another predictor of whether students will engage in environmentally responsible behavior is their locus of control, or feeling of effectiveness (Hines et al., 1987; Sia et al., 1985/86; Sivek and Hungerford, 1989/90; Marcinkowski, 1989; Matthews and Riley, 1995; Volk, 1993). Students with an internal locus of control feel a sense of empowerment and effectiveness in their actions which result in the willingness to perform responsible environmental behavior. Internal locus of control may be influenced when students, “have had the opportunity to apply these (citizenship action) skills successfully in the community” (Volk, 1993:51). Since the measurement of locus of control is beyond the scope of this research, it was not assessed in the evaluation.

In order to avoid the problems of only testing immediately after the cruise, I would suggest the same study design with modifications. Changes to the design include expanding the post-cruise testing to include additional standardized measurements at several consistent points. Assessments performed immediately after the cruise, several weeks after the cruise, several months after the cruise, and possibly years after the cruise are some recommendations (Table 12). The problem with this suggested design and the reason it was not used in this evaluation is that it is extremely difficult to track students across years, even months. If analyses are performed at the classroom level, tracking students over time is even more difficult.

Table 12. Study Design for Future Evaluations.

Study Group	Pre-test	Cruise Treatment	Immediate Post-test	Month Post-test	Year Post-test
Experimental (Pre & Post Surveys)	O	X	O	O	O
Control (Post-Only Survey)		X	O	O	O

Gender Differences Among Students

Pre-existing and Existing Gender Differences

Existing differences between boys and girls became apparent when pretest scores were analyzed. Our results showed that, both before and after the cruise, girls were more likely to express intentions to perform responsible environmental behaviors, while boys had significantly more outdoor and aquatic natural resource experiences. Higher experience levels in boys are similar to other research findings in which male youths had higher participation than females in wildlife-related activities (Wong-Leonard, 1992). It is interesting to note that the only experiences in which boys participated significantly more frequently than girls specifically relate to the aquatic outdoor activities of fishing, fishing in the Great Lakes, and snorkeling. Activities which did not specifically involve the outdoors, such as visits to aquaria or reading about aquatic natural resources, showed no differences between boys and girls.

Behavioral intentions scores by girls were significantly higher in our survey sample; this observation is consistent with the results of a recent study of 13,000 Michigan youth. Overall, girls have higher levels than boys of prosocial behavior such as “helping people who are hungry, sick, or unable to care for themselves,” and girls are also consistently more involved in volunteer work (Keith and Perkins, 1996:28).

Gender Differences in Cruise Effects

A gender difference which occurred as a result of the GLEP cruise includes a positive change in girls attitudes toward the Great Lakes. After the total student population was split according to gender, this significant positive attitude change became apparent in girls, but no significant change was seen in boys’ attitudes. It has been noted by several researchers that girls have more positive attitudes than boys toward animals and natural resources (Kellert and Westervelt, 1983; Pomerantz, 1977; Sanders, 1974; Westervelt and Llewellyn, 1985 all cited in Wong, 1992) (Kellert, 1985). If attitudinal changes are to occur in a positive direction, the fourth grade and lower elementary levels are the opportune times to teach environmental sensitivities and values (Kellert, 1985; Peterson and Hungerford, 1995; Volk, 1993).

Research Limitations

Specific limitations to this research include the attitude and behavioral intentions measurement scales. These scales may not have been discriminatory enough when measuring pretest scores, and as a result, may not have accurately measured changes in

attitudes and behavioral intentions. Further analysis correcting for possible ceiling effects in the data may reveal results which show significant changes in attitudes and/or behavioral intentions otherwise masked by the ceiling effect.

The testing procedure was also limited by the fact that there are many pre- and post-cruise activities which teachers can lead. Since teachers conduct these activities at varying levels, it was determined that only the cruise effects would be measured. To measure only the cruise effects, the pre and post surveys had to be administered as close to the cruise as possible.

To avoid these problems I suggest standardizing the pre- and post-cruise classroom activities so that all students are exposed to the same and equal amount of GLEP activities. This would help researchers to measure attitude and behavioral intentions changes due to GLEP, and to measure them consistently over time without high variability in students' instruction. The attitude and behavioral intentions scales would be easier to develop and administer on a student population which has had similar experiences, and assessments would measure the impacts of the same activities all students experience over time (Table 12). Perhaps, most importantly, future students would benefit from the research uniformity in that evaluations would be more precise and offer additional suggestions for concrete program improvements.

Recommendations

Overall, this GLEP evaluation provided extremely useful information in making recommendations to GLEP and its future evaluation. Specific recommendations to

improve GLEP and its evaluation as a result of this research include: 1) strengthening the on-board cruise curriculum and written classroom curriculum to have desired effects on attitudes, knowledge, and behavioral intentions, 2) improving evaluation and measurement of attitudes and behavioral intentions, 3) continuing evaluation of cruise experience and written curriculum effects on students, and 4) conducting longer-term follow-up evaluations with students.

In order to strengthen the cruise curriculum in the area of behavioral intentions, specific skills should be taught by an activity which can be performed and completed on the boat. An example might be using a fishing net to scoop trash out of the water or from the river banks. The written curriculum could be made stronger by following the suggestions in Appendix B; one example is to develop every activity to be Great Lakes and vessel/boat specific to maximize fourth grade Great Lakes learning and application of learning to individual behaviors.

To improve the measurement of attitudes and behavioral intentions, scales should be developed which are more discriminatory in assessing students in these constructs. High initial measurements should be avoided to eliminate problems with ceiling effects, which complicate the measurement of possible changes in attitudes and behavioral intentions. Consistent pre- and post-cruise classroom activities would also help to reduce variability in students in order to measure true effects of GLEP.

The evaluation of GLEP should continue with revised attitude and behavioral intentions scales and include assessments of the strengthened cruise experience. In addition, it is highly recommended that the evaluation include measurement of the effects

of the pre- and post-cruise classroom activities to more completely evaluate GLEP. As stated before, changes in attitudes and behavioral intentions seldom occur as a result of a single experience, and more changes may be present as a result of the entire program. Longer-term follow-up evaluations with students are suggested and would show persistent effects of the program over time.

Other vessel-based and marine and aquatic education programs could benefit from the findings in this study. Programs will be strengthened if both program design and evaluation models are taken into consideration. Rigorous evaluations of programs that include follow-up investigations are necessary for program improvement and to determine significant impacts on participants. Most importantly, multi-disciplinary education with proper emphasis on ecological knowledge, attitudes, and skills for taking action appropriate to the learning level should always be considered.

Recommendations for further research include evaluating program impacts as well as processes to assess actual learning and changes that occur in students as a direct result of a program. Impact evaluations should be conducted with valid and reliable measurement instruments to accurately measure real impacts of a program on participants. Limitations of previous research should be avoided to enhance and strengthen future research and evaluations.

APPENDICES

APPENDIX A

PROJECT APPROVAL BY THE UNIVERSITY COMMITTEE
ON RESEARCH INVOLVING HUMAN SUBJECTS (UCRIHS)MICHIGAN STATE
UNIVERSITY

October 3, 1995

TO: Shari L. Dann
118 Natural Resources Bldg.

RE: IRB#: 95-510
 TITLE: MULTI-DISCIPLINARY, VESSEL-BASED, ENVIRONMENTAL
 EDUCATION: AN EVALUATION OF THE GREAT LAKES
 EDUCATION PROGRAM
 REVISION REQUESTED: N/A
 CATEGORY: 1-B
 APPROVAL DATE: 10/02/95

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project and any revision listed above.

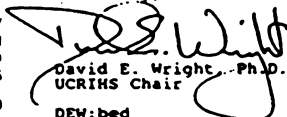
RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/
CHANGES: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)432-1171.

Sincerely,



David E. Wright, Ph.D.
UCRIHS Chair

DEW:bed

cc: Anne Bierzychudek

OFFICE OF
RESEARCH
AND
GRADUATE
STUDIESUniversity Committee on
Research Involving
Human Subjects
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FAX: 517/432-1171The Michigan State University
IDEA is Inspiring Diversity
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APPENDIX B**REVIEW OF THE GLEP CLASSROOM CURRICULUM****GLEP Curriculum Background**

The Great Lakes Education Program is a fourth grade classroom and field educational opportunity focusing on the Great Lakes. It currently targets students in the fourth grade because the Michigan State Board of Education mandates that students learn about the Great Lakes during their fourth grade year. Since Great Lakes topics are already in the students' curriculum at that level, GLEP designers concluded that fourth grade children would benefit the most from the program. It is designed to increase student interest in the Great Lakes and aquatic resources and build a better understanding of the students' roles as resource stewards. The Great Lakes Education Program has been developed with an emphasis on recognizing the multi-disciplinary nature of the Great Lakes and other water resource systems. The program integrates elements of history, geography, physical and biological sciences, mathematics, literature, and the arts.

The first phase of the program utilizes a developed written curriculum and focuses on classroom activities designed to familiarize students with the Great Lakes system and many related concepts. These concepts/topics include the water cycle, water quality, Great Lakes geology and geography, wetlands, the food chain, aquatic life forms, groundwater, and direct water uses.

The classroom curriculum was written primarily for fourth grade teachers to

introduce students to the Great Lakes ecosystem. It is also used by GLEP volunteers and personnel involved in preparation of future teachers.

Curriculum Framework

The organization of any curriculum must foster the meeting of program goals and objectives. Therefore, the organization should follow a conceptual framework in which coordinated concepts direct teaching towards a focused understanding (NAAEE Learners draft 1996). A solid framework offers a set of “building blocks” from which a curriculum can then be developed.

Examples of developmental frameworks can be seen in the Project Wild *Aquatic* and Project WET (Water Education for Teachers) curricula. Both guides contain conceptual frameworks derived from the well-accepted superordinate and aquatic environmental education goals (Hungerford and Volk 1990, Goodwin and Schaadt as cited in Fortner, 1991:303). Major aquatic concepts in the frameworks are defined and broken down further into topics and primary objectives. Specific activities are then developed and used to reach these objectives as well as to meet secondary objectives within the activity itself. (See Table B-1 for a partial example of a framework from the Project Wet curriculum.) The abbreviated framework shows specific activities which meet topical objectives. These activities meeting topical objectives are arranged under three major domains of study which are cognitive, affective, and skills oriented. Frameworks are not always trisected into these components, but appear to have somewhere between three and seven major parts. For example, Project WILD has seven

Table B-1. Project WET Curriculum Framework: A Partial Example (adapted from Project WET, 1995).

CONCEPTUAL FRAMEWORK	AFFECTIVE FRAMEWORK	SKILLS FRAMEWORK
■ Water connects all Earth systems. - Water is an integral part of Earth Structure. - Water plays a unique role in Earth processes. - The water cycle is central to all earth systems.	Note: Affective components are interrelated and difficult to classify into categories. ■ Attitudes toward water and water-related concepts and issues. - Opinions - Likes - Dislikes	■ Gathering information - Reading. - Observing - Measuring - Drawing - Recording - Collecting
● Activity: Capture, Store, and Release - Students will recognize that groundwater and precipitation can contribute water to wetlands. - Students will describe how wetlands capture, store, and release water.	● Activity: Dilemma Derby - Students will outline reasons why managing water resources can create dilemmas. - Students will identify, analyze, and select actions related to a water resource dilemma.	● Activity: Super Bowl Surge - Students will illustrate how demands on some treatment plants cause overflow. - Students will explain problems with sewage overflow. - Students will propose solutions to a water management problem. - Students will recognize how presentation strategies influence public policy.

major components, and the North American Association for Environmental Education (NAAEE) suggests a framework which contains six core ingredients for quality EE.

In addition to the framework, Project WET has topics, grade levels, teaching strategies, and activities all cross-referenced in separate charts to ease curriculum application. Important aquatic environmental concepts which can be difficult to understand are also fully described in chapter-like form.

The Great Lakes Education Program classroom curriculum has activities set up in a similar fashion (Table B-2). There are four aquatic environmental topical areas which are water, land, life, and people. Under each topic are subjects which are to be covered in the curriculum, and the activities which are included cover certain learning objectives.

In reviewing the Great Lakes Education Program framework, important components have been left out and/or need to be more adequately explained. Most of the basics are present, but a more in-depth interpretation will improve the overall curriculum and maximize student learning. Suggestions for the Great Lakes Education Program classroom curriculum framework include the following:

1. Explain in more detail the four environmental concepts.

EXAMPLE: Water is an integral part of Earth's structure and plays a unique role in Earth's processes. It is found in the atmosphere, on the surface, and underground. The water cycle is central to life on Earth and connects Earth systems (Project WET 1995)

2. State primary learning and/or behavioral objectives for each topic (could be benchmarks for fourth grade level).

EXAMPLE: After studying the water cycle students will have sound ecological knowledge of the movement of water through the water cycle, knowledge of

Table B-2. GLEP Curriculum Focus Areas: A Partial Example (adapted from GLEP Curriculum Guide, 1996).

<u>WATER</u>	<u>LAND</u>	<u>LIFE</u>	<u>PEOPLE</u>
The Water Cycle	Great Lakes	Food Chain/Web	Direct Water Uses
Water Quality	Geography and Geology	Predator/Prey Relationships	- Drinking
Water Body Types	- Historic		- Waste Disposal & Water Treatment
Water Levels	Glaciation	Aquatic Life Forms	- Recreation
	- Present	- Indicator	Boating
		- Typical	Fishing
		- Alien	Swimming
		Biological Water Requirements and Adaptations	Shipping/Navigation
		Alien (Non-Native) Species	- Shipwrecks

environmental issues, an understanding of environmentally responsible behavior, and applicable skills.

3. Review, revise, add, or delete any activities which do not address the primary objectives.

EXAMPLE: The four activities which are included for the water cycle cover the topic very well.

4. Within each activity itself, secondary objectives should be stated.

EXAMPLE: Activity 3: Randy Raindrop's Fantastic Journey Objectives: Students will be able to explain and follow water through the hydrologic cycle and identify environmental pollutants.

5. Add easy cross reference charts, such as, correlating Michigan standards and/or benchmarks with curriculum activities covering similar objectives.

EXAMPLE: Science Standard 7: Ecosystems - explain how parts of an ecosystem are related and how they interact; explain how energy is distributed; investigate and explain how communities change over time... GLEP Activities: Predator Prey; How do food chain members affect each other?; How do the members of a food web depend on each other?

In researching other vessel-based environmental education programs, there are no curricula which have complete conceptual frameworks for teachers to follow.

Curriculum Design

An acceptable curriculum design must be able to empower the learner to make sound decisions and take appropriate actions. As a leader in EE, the North American Association for Environmental Education (NAAEE) has established a set of guidelines to follow when developing or evaluating EE curricula and materials. The guidelines contain six key characteristics of high quality EE materials which best direct learners toward the goal of EE. These six characteristics include: 1) Fairness and Accuracy 2) Depth 3) Emphasis on skills building 4) Action orientation 5) Instructional soundness and

6) Usability. Included under the characteristics are guidelines and indicators which help to identify essential objectives and attributes in curricula (NAAEE Learners draft, 1996).

Excellent examples of curricula which have successfully incorporated key EE characteristics into their designs are, again, Project Wild *Aquatic* and Project WET. The educational designs involve the integration of subject matter, issue investigation, increased participation, and social action. These designs are consistent with EE's progressive philosophy arguing that knowledge and a keen mind are not enough for complete educational development.

Activity Structure

Classroom oriented curricula involve activities which address the concepts and objectives laid out in the conceptual frameworks. The primary organizational structure for activities in classroom EE curricula is quite standard and can be found as key characteristic #6, Usability, in NAAEE's guidelines for excellence (NAAEE Materials draft, 1996). The guidelines to follow are listed as:

- 6.1 *Clarity and logic.* The overall structure (purpose, direction, and logic of presentation) should be clear to educators and learners.
- 6.2 *Easy to use.* Materials should be inviting and easy to use.
- 6.3 *Long lived.* Materials should have a life span that extends beyond one use.
- 6.4 *Adaptable.* Materials should be adaptable to a range of learning situations.
- 6.5 *Accompanied by instruction and support.* Additional support and instruction should be provided to meet educators' needs.
- 6.6 *Make substantiated claims.* Materials should accomplish what they claim to accomplish (NAAEE Materials draft, 1996).

A standard activity layout from Project WET in Table B-3 clearly shows adequate

Table B-3. Project WET Activity Layout (Project WET, 1995).

Activity Format



Icon indicates the activity's placement within the conceptual framework.

■ **Grade Level:**
Suggests appropriate learning levels: Lower Elementary (K-2), Upper Elementary (3-5), Middle School (6-8), and High School (9-12).

■ **Subject Areas:**
Disciplines to which the activity applies.

■ **Duration:**
Preparation time: The approximate time needed to prepare for the activity. **NOTE:** Estimates are based on first-time use. Preparation times for subsequent uses should be less.

Activity time: The approximate time needed to complete the activity.

■ **Setting:**
Suggested site.

■ **Skills:**
Skills applied in the activity.

■ **Charting the Course**
Concepts and related Project WET activities that could be performed prior to, in conjunction with, and after the activity.

■ **Vocabulary**
Significant terms defined in the glossary.

A snappy, thought-provoking teaser introduces the activity. This can be presented as an ice breaker.

Summary

A brief description of the concepts, skills, and affective dimensions of the activity.

Objectives

The qualities or skills students should possess after participating in the activity. **NOTE:** Learning objectives, rather than behavioral objectives, were established for Project WET activities. To measure student achievement, see **Assessment**.

Materials

• *Supplies needed to conduct the activity.*
(Describes how to prepare materials prior to engaging in the activity.)

Making Connections

Describes the relevance of the activity to students and presents the rationale for the activity.

Background

Relevant information about activity concepts or teaching strategies.

Procedure

▼ Warm Up

Prepares everyone for the activity and introduces concepts to be addressed. Provides the instructor with preassessment strategies.

▼ The Activity

Provides step-by-step directions to address concepts. The primary component of each step is presented in bold-faced type.

NOTE: Some activities are organized into "parts." This divides extensive activities into logical segments. All or some of the parts may be used, depending on the

objectives of instruction. In addition, a few activities provide Options. These consist of alternative methods for conducting the activity.

▼ Wrap Up

Brings closure to the lesson and includes questions and activities to assess student learning. **NOTE:** Many Project WET activities include an "action" component *Wrap Up and Action*. Action moves learners beyond the classroom and involves friends, family, community, state, national, and/or international audiences.

Assessment

Presents diverse assessment strategies that relate to the objectives of the activity, noting the part of the activity during which each assessment occurs. Ideas for assessment opportunities that follow the activity are often suggested.

Extensions

Provides additional activities for continued investigation into concepts addressed in the activity. Extensions can also be used for further assessment.

☺ K-2 Option

Describes more concrete approaches to illustrate specific concepts for kindergarten through second-grade levels. This option is included in selected activities.

Resources

Lists references providing additional background information. Resources for direct use by students are marked with an ☺.

NOTE: This is a limited list. Several titles are suggested, but many other resources on similar topics will serve equally well.

inclusion of all the necessary components of a complete EE activity.

In the Great Lakes Education Program classroom curriculum there are activities with the standard organizational structure, but there are also activities with no structure. Certain subjects are covered very well, such as food chains, while others are not. In fact, the topic of exotic species has no activities at all; it is covered by two teacher fact sheets.

To improve the Great Lakes Education Program curriculum the existing organizational structure needs to be scrutinized activity by activity. When this is done the following problems become apparent:

1. Not all topics have activities.
2. Some activities are repeated.
3. Not all activities have objectives.
4. Activity structure is inconsistent; various activities are added in a collage fashion.
5. Some activities are designated for 6th-8th grade levels or higher in a 4th grade curriculum.
6. Not all activities have aquatic themes; for example, the predator/prey topic is covered by a northeast forest ecosystem.

Recommendations to strengthen the curriculum include:

1. addressing the six problems above.
2. making sure the entire curriculum is consistent, including the framework and activity structure.
3. developing every activity to be Great Lakes and vessel/boat specific for maximum fourth grade Great Lakes learning.
4. building the curriculum to be compatible with other existing aquatic curricula to use GLEP as supplemental material or to easily supplement GLEP.

Finally, a curriculum developed from a conceptual framework and standardized activity structure not only facilitates teaching and learning, but it also allows for two completely separate teaching strategies. Since the primary organizational structure of the

activities is easy to follow and gives teachers substantial structural information, an activity can be used by itself to supplement a teacher's lesson plans. Or, the activities can be used as they are organized to serve as already developed lesson plans due to the conceptual framework.

APPENDIX C

GLEP CRUISE SURVEY: THE FINAL INSTRUMENT

NAME _____

Date _____

CRUISE SURVEY

Great Lakes Education Program (GLEP)

DIRECTIONS

Please answer the following questions about the Great Lakes as well as you can.

This is not a test. Your answers to the questions will not be counted for a grade. Your name and your answers will be kept separate.

Are you a boy or a girl? (Check one)

_____ BOY _____ GIRL

How old are you?

_____ years old

I. FEELINGS ABOUT THE GREAT LAKES AND LAKE ST. CLAIR

In this section there are pairs of words to describe the Great Lakes. The words on the left are the opposite of the words on the right. Between the opposite words there are five numbers. Please circle the number in between the words which shows how you feel about the Great Lakes. There are no right or wrong answers for this section!

THE GREAT LAKES

EXAMPLE: big 1 2 3 4 5 small

If you feel the Great Lakes are very big, then you would circle number 1 as shown.

beautiful	1	2	3	4	5	ugly
fun	1	2	3	4	5	boring
strong	1	2	3	4	5	weak
familiar	1	2	3	4	5	strange
awful	1	2	3	4	5	nice
dirty	1	2	3	4	5	clean
important	1	2	3	4	5	unimportant
worthless	1	2	3	4	5	valuable

Please read each sentence in this section. For each sentence please circle TRUE if the sentence does describe you. Please circle MAYBE if the sentence may describe you sometimes. Please circle FALSE if the sentence does not describe you. There are no right or wrong answers for this section!

TRUE this sentence describes me	MAYBE this sentence sometimes describes me	FALSE this sentence does not describe me
--	--	--

TRUE	MAYBE	FALSE	I get mad about the damage pollution does to the Great Lakes.
TRUE	MAYBE	FALSE	I get scared to think people do NOT care about the Great Lakes.
TRUE	MAYBE	FALSE	I do NOT worry about Great Lakes environmental problems.
TRUE	MAYBE	FALSE	It upsets me when I see people use too much water.
TRUE	MAYBE	FALSE	I am NOT frightened about the effects of pollution on my family.
TRUE	MAYBE	FALSE	It makes me sad to see houses being built on wetlands.
TRUE	MAYBE	FALSE	To save water, I would be willing to turn off the water while I brush my teeth.
TRUE	MAYBE	FALSE	To save water, I would be willing to use less water when I bathe.
TRUE	MAYBE	FALSE	I would NOT give \$15 of my own money to help the Great Lakes.
TRUE	MAYBE	FALSE	I would be willing to pass out Great Lakes information.
TRUE	MAYBE	FALSE	I would be willing to write letters asking people to help stop Great Lakes pollution.
TRUE	MAYBE	FALSE	I would be willing to pick up litter when I am at a Great Lakes beach.
TRUE	MAYBE	FALSE	I am interested in a career related to the Great Lakes, rivers, lakes, or oceans.

II. WHAT DO YOU KNOW ABOUT THE GREAT LAKES AND LAKE ST. CLAIR?

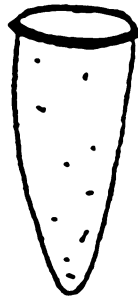
In this section of the survey read each question carefully. Choose the one answer that you feel is the most correct. Please circle the letter in front of your answer.

1. Food, water, cover and space are part of an animal's:
A. habits.
B. nature.
C. habitat.
D. behavior.
2. What is a plankton net used for?
A. To keep bait fresh on the boat.
B. To catch fish without hurting them.
C. To measure oxygen in the water.
D. To catch tiny floating plants and animals.
3. On the map, which lake in the Great Lakes region forms most of Michigan's western border?
A. Lake Superior.
B. Lake Michigan.
C. Lake Erie.
D. Lake Ontario.
E. Lake Huron.
F. Lake St. Clair.
4. On the map, place an X on Lake St. Clair.
5. Which waterway connects the Great Lakes to the Atlantic Ocean?
A. Gulf Stream.
B. St. Lawrence Seaway.
C. Lake Superior.
D. Mississippi River.
6. The land area from which a river collects its water is called a
A. gradient.
B. watershed basin.
C. flood plain.
D. river bottom



7. An important difference between oceans and the Great Lakes is that oceans:
 - A. have waves.
 - B. have algae.
 - C. are polluted.
 - D. are salty.
8. Which statement about fish is wrong?
 - A. fish have fins.
 - B. fish have lungs.
 - C. fish are cold-blooded.
 - D. fish are good swimmers.
9. What do fish need to live?
 - A. a place to hide.
 - B. food.
 - C. the right water temperature.
 - D. enough space to swim.
 - E. all of the above.
10. An example of an exotic or non-native invader found in the Great Lakes is the:
 - A. sucker.
 - B. turtle.
 - C. zebra mussel.
 - D. Canada goose.
 - E. all of the above.
11. Which is a plant that lives in water?
 - A. ivy.
 - B. minnow.
 - C. sunflower.
 - D. algae.
 - E. mushroom.
12. Which of the following lives on the bottom of Lake St. Clair?
 - A. nothing.
 - B. blind fish.
 - C. benthos.
 - D. octopus.
13. What could acid rain do to a lake?
 - A. cause fewer fish to hatch from eggs.
 - B. hurt some types of plants and animals.
 - C. make water more acidic.
 - D. change the number of plants and animals.
 - E. all of the above.

14. What is a D.O. test for?
 A. To measure algae in the water.
 B. To measure plankton in the water.
 C. To measure oxygen in the water.
 D. To measure ozone in the water.



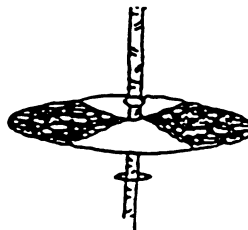
15. The zooplankton in the picture are:
 A. sand grains.
 B. plants.
 C. animals.
 D. salt/minerals.
 E. all of the above.

16. Why is it suggested that people eat Great Lakes fish only once in a while?
 A. Fish from the Great Lakes cost more than other fish.
 B. Since very few fish live in the Great Lakes, people should eat only a few of them.
 C. Some fish from the Great Lakes have pollutants inside them.
 D. Fish from the Great Lakes spoil faster than fish from rivers.

17. Which food chain is in the right order?
 A. water insects → water plants → fish → people.
 B. water insects → fish → water plants → people.
 C. water plants → water insects → fish → people.
 D. people → water plants → fish → water insects.
 E. fish → people → water insects → water plants.

18. What does a goose need in order to live?
 A. large pine forests.
 B. lakes, ponds, or wetlands.
 C. berries and nuts.
 D. a tree with holes in it.

19. What is a Secchi disk used for?
 A. To record information on a computer.
 B. To play a water game like frisbee.
 C. To measure how clear the water is.
 D. To measure oxygen in the water.



20. Energy for aquatic life comes from the:
- A. sun.
 - B. water.
 - C. soil.
 - D. rocks.
21. Marshes may be disappearing because:
- A. high sea level is making the oceans and Great Lakes grow larger.
 - B. marsh water is draining out into the oceans.
 - C. people are filling in the marshes to make more land.
 - D. there is less rain to fill the marshes.
22. Plankton are:
- A. a school of fast moving fish.
 - B. tiny floating plant and animal life.
 - C. non-living substances in the water.
 - D. material for making wooden boats.

 III. EXPERIENCES

Please circle the answers that show which activities YOU have done BEFORE YOUR CRUISE

Have you ever gone fishing?..... YES NO NOT SURE

Before your cruise, have you visited the Great Lakes
or Lake St. Clair?..... YES NO NOT SURE

Have you ever gone fishing in one of the Great Lakes?..... YES NO NOT SURE

Do you have an aquarium at home with fish living in it?.... YES NO NOT SURE

Do you belong to 4-H, Boy Scouts, or Girl Scouts?..... YES NO NOT SURE

Have you gone to a zoo?..... YES NO NOT SURE

Have you gone to an aquarium
or Sea World?..... YES NO NOT SURE

Does your family go camping?..... YES NO NOT SURE

Have you tried to learn how to swim?..... YES NO NOT SURE

Have you ever been scuba diving or snorkeling?..... YES NO NOT SURE

Have you done classroom activities about
water, the oceans, or the Great Lakes?..... YES NO NOT SURE

Have you watched nature programs on TV about
water, the oceans, or the Great Lakes?..... YES NO NOT SURE

Have you read books or magazines about
water, the oceans, or the Great Lakes?..... YES NO NOT SURE

Before your cruise, have you ever been on a
motorboat, sailboat, or canoe?..... YES NO NOT SURE

THANK YOU

THANK YOU

THANK YOU

THANK YOU

Test¹ = Pre=Experimental Pre-test, Pst=Experimental Post-test, PO=Control Post-Onlytest
1² = 1, 2, 3, 4, 5 = Scale rating adjective pairs.
9³ = No answer available.

APPENDIX D

RESULTS FROM STUDENT SURVEY

Table D-1. Distribution of Experimental and Control Group Student Responses on Attitude Scale Items.

Test ¹	% Student Response							9 ³
		1 ²	2	3	4	5		
Pre	beautiful	54.4	31.5	11.5	2.0	.6	ugly	0
Pst		57.9	25.8	13.3	1.6	1.4		0
PO		47.8	32.2	15.3	2.2	2.0		.4
Pre	fun	60.7	23.4	11.7	2.4	1.4	boring	.4
Pst		65.3	21.8	9.5	1.2	2.2		0
PO		60.9	23.8	10.2	2.2	2.4		.4
Pre	strong	48.2	25.4	22.2	2.6	1.4	weak	.2
Pst		52.8	24.4	19.8	1.4	1.6		0
PO		44.4	28.2	20.4	4.2	2.2		.4
Pre	familiar	59.7	18.1	13.9	3.4	4.8	strange	0
Pst		64.7	19.4	11.3	1.0	3.4		.2
PO		60.7	19.6	12.7	2.2	4.4		.4
Pre	awful	2.4	1.8	9.5	19.6	66.7	nice	0
Pst		2.4	2.6	9.1	21.2	64.7		0
PO		3.6	1.8	7.6	19.3	67.6		.2
Pre	dirty	9.5	9.3	44.6	22.4	14.3	clean	0
Pst		9.7	8.3	42.5	22.4	17.1		0
PO		9.8	10.4	43.3	22.2	13.8		.4
Pre	important	87.7	8.7	1.6	.2	1.8	unimportant	0
Pst		86.3	8.9	2.6	.2	2.0		0
PO		90.0	5.6	1.8	1.1	1.3		.2
Pre	worthless	3.2	1.8	7.9	12.5	74.6	valuable	0
Pst		2.4	1.2	6.7	15.3	74.4		0
PO		3.3	.7	5.1	9.3	81.3		.2

Table D-2. Distribution of Experimental and Control Group Student Responses on Behavioral Intention Scale Items.

Question	Test ¹	% Student Response			9 ²
		False	Maybe	True	
mad about pollution damage?	Pre	2.0	20.8	76.6	.6
	Pst	2.4	21.6	75.8	.2
	PO	2.2	23.3	74.2	.2
scared people don't care?	Pre	11.7	43.1	45.2	0
	Pst	12.7	39.9	47.2	.2
	PO	15.1	43.6	41.1	.2
not worried about env. problems?	Pre	78.8	15.5	5.6	0
	Pst	78.6	15.5	5.6	.2
	PO	81.6	14.0	4.4	0
upset when see people use too much water?	Pre	20.2	48.6	30.6	.6
	Pst	17.3	43.5	38.7	.4
	PO	23.8	49.1	26.7	.4
not frightened of pollution effects on family?	Pre	75.4	14.1	10.3	.2
	Pst	75.4	15.9	8.5	.2
	PO	76.9	14.7	7.8	.7
sad to see houses built on wetlands?	Pre	10.3	30.8	58.5	.4
	Pst	7.9	30.0	61.7	.4
	PO	8.7	27.8	63.6	0
willing to turn off water while brushing teeth?	Pre	3.6	11.1	84.9	.4
	Pst	3.2	15.1	81.0	.6
	PO	4.2	14.0	81.6	.2
willing to use less water when bathe?	Pre	6.9	26.6	66.5	0
	Pst	6.0	32.9	60.9	.2
	PO	11.6	32.7	55.8	0
not give own \$15 to help the Great Lakes?	Pre	58.5	32.9	8.7	0
	Pst	54.0	33.7	11.9	.4
	PO	48.7	37.3	14.0	0
willing to pass out Great Lakes information?	Pre	6.7	33.9	59.3	.2
	Pst	7.3	31.9	60.5	.4
	PO	6.7	29.3	63.8	.2

Table D-2 (cont'd).

Question	% Student Response				9 ²
	Test ¹	False	Maybe	True	
willing to write letters to help stop pollution?	Pre	9.9	30.8	59.1	.2
	Pst	13.1	32.1	54.4	.4
	PO	10.7	37.6	51.6	.2
willing to pick up litter at Great Lakes beach?	Pre	3.2	26.8	70.0	0
	Pst	4.0	33.5	62.1	.4
	PO	5.3	30.7	63.8	.2
interested in career related to aquatics?	Pre	25.6	45.4	28.8	.2
	Pst	29.4	40.9	29.0	.6
	PO	33.3	43.8	22.9	0

Test¹ = Pre = Experimental Pre-test.

Pst = Experimental Post-test.

PO = Control Post-Only test.

9² = No answer available.

Table D-3. Distribution of Experimental and Control Group Student Responses on Knowledge Scale Items.

Question	Test ¹	% Student Response							
		A ²	B	C	D	E	F	99 ³	9 ⁴
habitat is what?	Pre	6.0	26.4	65.3	1.8	---	---	---	.4
	Pst	5.8	22.4	70.2	1.4	---	---	---	.2
	PO	6.2	25.8	66.2	1.8	---	---	---	0
plankton net's use?	Pre	4.0	33.3	10.1	52.0	---	---	---	.6
	Pst	.2	3.0	4.8	91.7	---	---	---	.2
	PO	.7	2.4	8.0	88.7	---	---	---	.2
MI western border?	Pre	13.9	63.7	5.4	3.0	8.9	4.0	---	1.0
	Pst	10.9	70.2	3.6	2.4	5.2	7.5	---	2.8
	PO	17.1	62.0	3.1	3.1	6.9	6.9	---	.9
put X on Lake St. Clair?	Pre	5.0	1.0	8.1	3.4	13.3	64.4	2.6	3.8
	Pst	1.6	.8	4.2	1.4	9.9	76.4	2.8	2.8
	PO	2.4	1.3	4.9	1.1	8.4	79.1	2.0	.7
waterway connects ocean?	Pre	11.7	44.4	24.0	19.4	---	---	---	.6
	Pst	6.7	58.1	22.2	12.1	---	---	---	1.0
	PO	11.3	52.4	23.1	12.9	---	---	---	.2
watershed is what?	Pre	14.3	45.2	13.7	26.2	---	---	---	.6
	Pst	10.9	55.0	11.9	21.4	---	---	---	.8
	PO	9.1	56.2	12.4	21.3	---	---	---	.9
oceans are salty?	Pre	3.4	3.6	5.2	87.5	---	---	---	.2
	Pst	2.2	3.8	5.8	87.7	---	---	---	.4
	PO	4.2	3.3	6.0	86.2	---	---	---	.2
fish have lungs is wrong.	Pre	2.8	67.9	25.8	3.2	---	---	---	.2
	Pst	2.0	72.2	21.1	3.8	---	---	---	.8
	PO	3.3	61.8	3.0	4.9	---	---	---	0
fish need to live?	Pre	.6	16.3	9.7	2.2	70.6	---	---	.6
	Pst	.8	14.7	7.1	1.6	75.4	---	---	.4
	PO	.4	10.0	9.8	1.6	78.2	---	---	0
exotic invader in lakes?	Pre	15.3	6.5	44.0	16.1	16.7	---	---	1.4
	Pst	18.8	2.4	50.6	12.1	15.9	---	---	.2
	PO	14.2	3.1	52.2	12.2	18.2	---	---	0

Table D-3 (cont'd).

Question	Test ¹	% Student Response							
		A ²	B	C	D	E	F	99 ³	9 ⁴
plant living in water?	Pre	3.2	4.4	.4	91.3	0?	---	---	.6
	Pst	2.6	4.4	.4	90.7	1.4	---	---	.4
	PO	2.9	3.3	.7	92.4	.7	---	---	0
lives on bottom of lake?	Pre	12.5	20.2	57.3	9.7	---	---	---	.4
	Pst	11.9	17.7	65.7	4.0	---	---	---	.6
	PO	14.2	14.7	62.0	8.7	---	---	---	.4
acid rain does what?	Pre	3.0	20.8	7.7	6.0	62.3	---	---	.2
	Pst	2.6	16.9	9.3	5.2	65.3	---	---	.6
	PO	2.0	18.2	8.9	7.3	63.6	---	---	0
D.O. test is for what?	Pre	17.1	23.4	44.6	14.7	---	---	---	.2
	Pst	6.3	32.3	53.8	6.7	---	---	---	1.0
	PO	9.6	34.7	48.9	6.4	---	---	---	.4
zoo-plankton are ?	Pre	15.7	12.5	23.4	27.2	20.8	---	---	.4
	Pst	3.8	13.7	56.7	8.1	16.7	---	---	1.0
	PO	3.8	16.7	59.3	4.4	15.8	---	---	0
eat few fish why?	Pre	2.8	30.2	58.7	7.9	---	---	---	.4
	Pst	2.2	27.4	62.5	5.0	---	---	---	2.8
	PO	2.0	26.0	64.2	7.3	---	---	---	.4
food chain in order?	Pre	12.9	4.2	64.7	14.5	3.2	---	---	.4
	Pst	11.3	3.6	66.9	14.9	2.6	---	---	.6
	PO	19.6	2.9	59.6	15.1	2.9	---	---	0
goose needs to live?	Pre	1.6	87.5	9.7	.8	---	---	---	.4
	Pst	1.0	92.1	5.4	.8	---	---	---	.6
	PO	.9	94.7	3.6	.4	---	---	---	.4
Secchi disk for?	Pre	15.1	2.6	56.7	25.4	---	---	---	.2
	Pst	2.6	1.6	77.6	17.1	---	---	---	1.0
	PO	5.1	1.1	78.2	15.6	---	---	---	0
aquatic energy from?	Pre	53.4	63.5	8.3	1.4	---	---	---	.4
	Pst	58.1	32.3	7.5	1.6	---	---	---	.6
	PO	53.1	40.4	5.1	.9	---	---	---	.4

Table D-3 (cont'd).

Question	Test ¹	% Student Response							
		A ²	B	C	D	E	F	99 ³	9 ⁴
marshes gone because?	Pre	6.3	13.7	64.5	14.9	---	---	---	.6
	Pst	5.2	10.5	77.8	5.8	---	---	---	.6
	PO	4.7	13.8	71.8	9.3	---	---	---	.4
plankton are what?	Pre	8.1	71.0	16.1	4.8	---	---	---	0
	Pst	1.6	89.7	6.0	2.0	---	---	---	.6
	PO	2.2	92.4	4.4	.4	---	---	---	.4

Test¹ = Pre = Experimental Pre-test.

Pst = Experimental Post-test.

PO = Control Post-Only test.

A² = A,B,C,E,D,F = Answers to knowledge questions with the correct answer highlighted.

99³ = Answer marked with an X was placed on land instead of Lake St. Clair.

9⁴ = No answer available.

Table D-4. Distribution of Experimental and Control Group Student Responses on Experience Scale Items.

Experience Variable	Test ¹	% Student Response			
		Yes	No	Not sure	No answer
have you ever gone fishing?	Pre	89.1	9.7	1.2	0.0
	Pst	88.1	10.3	1.2	0.4
	PO	85.6	12.2	1.6	0.7
visited the Great Lakes or Lake St. Clair?	Pre	62.5	20.2	16.3	1.0
	Pst	72.2	14.3	12.5	1.0
	PO	65.8	19.3	14.9	0.0
have you gone fishing in one of the Great Lakes?	Pre	34.3	45.4	19.8	0.6
	Pst	40.7	40.9	17.9	0.4
	PO	34.2	45.6	20.0	0.2
do you have an aquarium with fish?	Pre	39.3	59.5	0.8	0.4
	Pst	39.5	59.1	0.8	0.6
	PO	39.1	59.6	0.9	0.4
belong to 4-H, Boy Scouts, or Girl Scouts?	Pre	20.8	76.4	2.4	0.4
	Pst	19.8	76.2	3.6	0.4
	PO	20.9	77.1	1.6	0.4
have you gone to a zoo?	Pre	98.2	1.2	0.2	0.4
	Pst	97.8	1.2	0.2	0.8
	PO	97.6	1.1	1.1	0.2
have you gone to an aquarium or Sea World?	Pre	79.4	12.9	7.7	0.0
	Pst	79.2	12.9	7.1	0.8
	PO	81.1	12.7	6.0	0.2
does your family go camping?	Pre	59.1	35.1	5.6	0.2
	Pst	60.5	33.3	5.6	0.6
	PO	58.2	35.6	5.3	0.9
have you tried to learn how to swim?	Pre	96.4	2.4	0.6	0.0
	Pst	96.6	2.0	0.6	0.8
	PO	95.1	3.8	1.1	0.0
ever been scuba diving or snorkeling?	Pre	32.5	58.7	8.1	0.8
	Pst	34.7	56.3	7.9	1.2
	PO	32.9	58.4	8.4	0.2

Table D-4 (cont'd).

Experience Variable	Test¹	% Student Response			
		Yes	No	Not sure	No answer
done classroom activities about aquatics?	Pre	83.9	6.3	9.7	0.2
	Pst	88.5	3.4	7.5	0.6
	PO	86.2	5.6	8.2	0.0
watch nature programs on TV about aquatics?	Pre	73.4	16.5	9.9	0.2
	Pst	75.6	13.3	10.5	0.6
	PO	69.1	19.3	11.3	0.2
read books or magazines about aquatics?	Pre	67.3	17.3	15.1	0.2
	Pst	65.5	21.0	13.1	0.4
	PO	57.1	29.3	13.6	0.0
ever been on a motorboat, sailboat, or canoe?	Pre	92.1	5.0	2.6	0.2
	Pst	90.7	5.4	3.4	0.4
	PO	88.7	7.6	3.6	0.2

Test¹ = Pre = Experimental Pre-test.

Pst = Experimental Post-test.

PO = Control Post-Only test.

APPENDIX E

GLEP EVALUATION TEACHER CONTACT MATERIALS



MICHIGAN STATE
UNIVERSITY
EXTENSION

Department of Fisheries and Wildlife
13 Natural Resources Building
East Lansing, Michigan 48824
(517) 353-4477 FAX (517) 336-1699
Effective 7/23/94 our FAX number (517) 432-1699

April 23, 1996

Dear Fellow Educator,

Thank you for participating in the Great Lakes Education Program (GLEP) and helping with its evaluation. After several years of program existence, we are excited to begin a new evaluation process. We are glad you and your 4th grade class had the opportunity to participate.

We have searched for ways that other teachers and aquatic educators throughout the U.S. have tested youth knowledge gains. From that search we developed a GLEP survey specifically for your students. The survey is intended to detect changes in Great Lakes knowledge and attitudes, and intentions to be responsible toward aquatic resources. Results from the GLEP evaluation are intended to provide information to be used to improve the program.

As a token of our appreciation, we have a set of educational posters available for you. Thank you very much for your time and help in making GLEP a better program.

If you have any questions or comments, please feel free to call us.

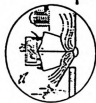
Sincerely,

A handwritten signature in cursive script, reading "Anne Bierzychudek".

Anne Bierzychudek
Graduate Assistant
(517) 353-0308

A handwritten signature in cursive script, reading "Shari Dann".

Shari Dann
Assistant Professor
(517) 353-0675



We Need Your Help!

To Evaluate the Success of the GLEP Experience.

• What type of evaluation?

The Great Lakes Education Program is undertaking a detailed evaluation effort to determine whether it is achieving its desired goals. The evaluation includes teacher and volunteer focus groups and student surveys. Pencil and paper surveys will be used to detect changes in students' Great Lakes knowledge, attitudes, and behaviors towards their aquatic resources.

• Why is the evaluation needed?

Results of the evaluation will be used for several purposes which include:

- improving the existing program.
- exporting the program to other Great Lakes areas.
- expansion to the 7th and 10th grades.

Dr. Shari Dann gives a post-test at Metro Beach Park. Newman's 4th grade class from Harmon Elementary.

Photo

Amy Nevada conducts a pre-test in Mrs. Wynn's 4th grade classroom at Sugarbush Elementary School in the fall of 1995.

• How will it be done?

The evaluation will be done in two sections. Teachers and cruise leader volunteers will discuss the program in focus groups while student participants will take part in pre- and post-tests. The pre-test will be given in your classroom prior to the students' vessel experience, and the post-test will be given as soon as possible following the trip down the Clinton River. Both tests will be administered by GLEP personnel. Signed permission slips to participate in GLEP's cruise and its evaluation are required prior to taking the pre-test.

Photo

• Who is doing this?

Michigan Sea Grant and Michigan State University Extension sponsor GLEP and will also conduct its evaluation. Michigan State University graduate students Anne Bierzychudek and Amy Nevada under the advice of Dr. Shari Dann will be working on the evaluation as required by their master's programs. Amy Nevada plans to coordinate teacher and cruise leader volunteer focus groups, while Anne Bierzychudek will be in charge of student surveys. If you have any further questions, please feel free to contact Anne or Amy at (517)553-0308.

Photo

"If we want to convince the educational community that environmental education can improve the curriculum and make it more relevant to students, we must evaluate our programs."

*Dr. Dean Bennett
University of Maine,
Farmington*

Photo

Photo

Photo

Photo

The Great Lakes Education Program Evaluation



Michigan Sea Grant Extension
Michigan Sea Grant College Program

"Paramount in efforts to integrate experiential education into more mainstream learning will be the ability to provide concrete evidence as to program accomplishments."

*Richard Flor
University of Minnesota*

**GREAT LAKES EDUCATION PROGRAM
PARENT/GUARDIAN INFORMATION AND RELEASE FORM**

Student Name: _____

Parent/Guardian Name: _____

School: _____

Teacher: _____

The student listed above will soon take part in a field trip with the Great Lakes Education Program. As part of this program, we would like to have students participate in a survey asking about their Great Lakes knowledge and interests. The information received from the students will help us improve the Great Lakes Education Program for future participants! Michigan State graduate students will be performing the evaluation, and parent signatures are needed in order to use the information collected from minors. Participation of students is voluntary, and there will be no penalty for nonparticipation. Names of student participants will be kept confidential; students' surveys will not be associated with their names. If you would like any additional information about this evaluation, please contact: Great Lakes Education Program staff at (810)469-5180, or Shari Dann at (517)353-0675.

As a parent/guardian of the student listed above, I give my permission for this student to take part in the survey evaluation of the Great Lakes Education Program.

(Parent/Guardian Signature)

(Date)

**GREAT LAKES EDUCATION PROGRAM
PARENT/GUARDIAN INFORMATION AND RELEASE FORM**

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(Parent/Guardian Signature)

(Date)



MICHIGAN STATE
UNIVERSITY
EXTENSION

Department of Fisheries and Wildlife
13 Natural Resources Building
East Lansing, Michigan 48824
(517) 355-4477 FAX (517) 336-1699
Effective 7/23/94 our FAX number (517) 432-1699

April 23, 1996

Dear Fellow Educator,

Thank you for participating in the Great Lakes Education Program (GLEP) and helping with its evaluation. After several years of program existence, we are excited to begin a new evaluation process. We are glad you and your 4th grade class had the opportunity to participate.

We have searched for ways that other teachers and aquatic educators throughout the U.S. have tested youth knowledge gains. From that search we developed a GLEP survey specifically for your students. The survey is intended to detect changes in Great Lakes knowledge and attitudes, and intentions to be responsible toward aquatic resources. Results from the GLEP evaluation are intended to provide information to be used to improve the program.

As a token of our appreciation, we have a set of educational posters available for you. Thank you very much for your time and help in making GLEP a better program.

If you have any questions or comments, please feel free to call us.

Sincerely,

Anne Bierzychudek

Anne Bierzychudek
Graduate Assistant
(517) 353-0308

Shari L. Dann

Shari Dann
Assistant Professor
(517) 353-0675

GLEP Cruise Conditions

Teacher _____ School _____

Which cruise did your class take? DATE _____ am _____ pm _____

Please circle and comment on the weather conditions the day of your cruise:

Cold (<55 degrees F)

Warm (55- 72 degrees F)

Hot (>72 degrees F)

Sunny

Partly Sunny

Cloudy

Light Rain

Heavy Rain

Windy

<1 ft. waves (calm)

1-2 ft. visible waves (rollers)

2-3 ft. large waves (rough)

Were whitecaps visible?

YES

NO

Comments: _____

How many students were on the cruise? _____ How many parent chaperones were on it? _____

Did you participate in the program at the Metro Beach Nature Center? _____ YES _____ NO

Please add any other conditions you feel may be relevant to your class's learning on the cruise.

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