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TRACY LEIGH MCMULLEN

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COMPARATIVE EVALUATION OF A DISTANCE LEARNING "VIRTUAL" PROGRAM AND A TRADITIONAL ON-SITE PROGRAM AT POTTER PARK ZOO IN LANSING, MI

By

Tracy Leigh McMullen

A THESIS

Submitted to
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ABSTRACT

COMPARATIVE EVALUATION OF A DISTANCE LEARNING "VIRTUAL" PROGRAM AND A TRADITIONAL ON-SITE PROGRAM AT POTTER PARK ZOO IN LANSING, MI

By

Tracy Leigh McMullen

Distance learning programs are becoming increasingly common in informal learning facilities such as zoos, aquaria and museums. While evaluation of informal education programs with respect to customer satisfaction and other qualitative measures have been gaining recognition, quantitative evaluations are not as common. This study addressed the lack of empirical evidence by comparing children's knowledge gain from traditional on-site programming with that of "virtual" distance learning programs.

Study results have supported the use of distance learning tools in informal education. On-site and virtual groups showed a comparable increase in knowledge gain. Traditional programs can be successfully adapted to be virtual programs. No differences were found between groups, indicating that, in the right circumstances, virtual and on-site programming can be used interchangeably with no loss of educational effectiveness.

To the people that understood why I did this

&

what it took to accomplish

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I would like to acknowledge my advisor, Dr. Richard Snider. I would also like to thank the other members of my committee, Dr. Gail Vanderstoep and Dr. James Smith.

Thank you to the teachers, students and principals of St. Johns Middle School and Perry Middle School. I would also like to thank the Potter Park Zoo and the Zoological Society. Without your participation and assistance none of this research could have been conducted.

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CHAPTER 1

INTRODUCTION

The learning environment in formal and informal settings has been changing. School districts are under pressures from taxpayers to make the most of the money they receive. School districts such as Perry Public Schools and St. Johns Public Schools in Michigan have restricted field trip funding and, in many cases, students must pay for their own transportation in addition to field trip costs. With increasing fuel prices, this becomes a heavy financial burden. Although scheduled visits to informal learning facilities have become accepted, or even expected, parts of the school program (Melton et al. 1996), funding restrictions have caused many teachers to cease offering field trips as a curriculum option. In addition to monetary issues, schools choosing to offer field trips now must also consider stricter district policies on increased security and the increased need for chaperones.

Distance learning (or education) tools are becoming increasingly important to education in public school and informal learning environments such as zoos and aquaria. Three-fourths of public school districts in the United States plan to offer or expand distance education programs (eSchool News 2005). Distance learning provides a method to deliver information through satellite communication, teleconferencing, and the Internet. These "virtual" programs provide a powerful and cost effective tool for program delivery to large numbers of people, especially when the students are dispersed across large geographic areas (Madhavan & Ray 2001).

Many school districts, not only in Michigan, but throughout the country, lack the funding for student field trips to zoos and aquaria (Zophy 1998).

Therefore, the potential cost effectiveness of virtual programs attracts schools to consider this new approach to message delivery. Many zoos and aquaria are developing virtual programs that take advantage of distance education technology to provide lower-cost student experiences (COSI 2004). As the use of distance learning within informal education institutions increases, its potential advantages over on-site education have come under scrutiny and are being evaluated more closely (Mohan-Mehrotra et al. 2001). Because distance learning virtual programming is continuing to expand without undergoing much evaluation, program weaknesses must be identified and addressed.

Study Purpose

The purpose of this study was to compare effectiveness of distance virtual education to that of on-site education for the "Clownfish, Corals and Conservation" exhibit at the Potter Park Zoo, in Lansing, MI.

Within this goal, more specific objectives were:

- to identify teacher needs and preferences with respect to field trips and informal education programming;
- to determine if traditional on-site educational programming is effective for knowledge gain;
- to determine if an on-site education program can be adapted to be delivered effectively, with respect to knowledge gain, using distance learning technology;

- to assess the relative effectiveness of the two types of programming with respect to knowledge gain; and
- to complete a qualitative evaluation of teachers' opinions about the value and ease of use of both types of educational programs.

Alternative Hypothesis: Evaluation of the "Clownfish, Corals and Conservation" educational programming will show that distance learning "virtual" programs are more effective than on-site programs in increasing knowledge gain scores.

Null Hypothesis: Evaluation of the "Clownfish, Corals and Conservation" educational programming will show that distance learning "virtual" programs are no different in educational effectiveness than on-site programs.

Criteria for rejection: The hypothesis null will be rejected if either or both the following result:

- results show a significant difference between pre- and posttest knowledge gain scores for students participating in virtual and on-site programs.
- results show significantly higher or lower knowledge gain for virtual programs than those participating in on-site programs.

Delimitations

This study was restricted to a tele-videoconferencing distance learning program within a zoo's aquarium exhibit. Primary participants of the study were limited to upper elementary and middle school students. The study participants came from small school districts outside of the immediate zoo area and were of comparable economic and social characteristics. Only school districts with distance learning technology were approached to participate in the study.

CHAPTER 2

LITERATURE REVIEW

Literature Review

New technology used in education can have both advantages and disadvantages: students may be reluctant to engage in activities, refuse to participate, or may not have adequate knowledge to use distance learning equipment. There is debate within the informal learning community that distance learning would decrease numbers of schools that participate in traditional field trips because they find that distance learning is an effective replacement. Distance learning program effectiveness then comes into question. Relatively little information is available about whether or not educational exhibits and programs actually result in measurable learning (Ayers 1998).

Before virtual programming can be evaluated, programs must be developed that take into account learner needs, learning environment, and teacher needs (Harry et al. 1993). Programs must be developed around central educational objectives and goals; if these are met, as evidenced by objective evaluation methods, a program can be deemed effective (Calder 1994).

Such programs have been said to lack the richness of traditional learning environments, as well as one-on-one teacher support and resources that students need (Mohan-Mehrotra et al. 2001), but thoughtful program design could eliminate these issues. The most prevalent concern for schools is the initial monetary investment for technological setup, which includes extra staff and equipment (Mohan-Mehrotra et al. 2001; Litwak 1991). Financial burdens would be justified if "virtual" programs surpass on-site programs in terms of educational benefits. However, the relative value of the two approaches to student progress has not been assessed. Seven criteria can be used to measure educational effectiveness: knowledge gain, level of engagement of students, post-experience exploration, critical thinking skills, scientific method skills, emotional connection, and satisfaction (Belanger and Jordan 2000; Calder 1994).

Using virtual programming, zoos and aquaria can go to where the customers are, increase participant numbers, and lower program costs for schools by utilizing more technology and less zoo staff time (Zophy 1998). The importance of science education that uses real-world examples has in recent years been a major factor in taking field trips to informal education facilities (Rennie & McClafferty 1995; and Jones 1997). As the political, economical and pedagogical environments of school districts are changing, so must informal education facilities vying for their business. Zoos, aquaria, museums, and nature centers must all adapt to the new environment. Many zoos and aquaria throughout the country have initiated distance learning programs focused on exhibit themes. Many programs meet state curriculum standards. Some, such as those at the Alaska SeaLife Center in Seward, are aligned not only with state but also national standards to widen their audience base, even attracting international classes. While primarily relying on videoconferencing, some programs also include hands-on activities tailored to individual grade levels, such as those offered by the Columbus Zoo in Ohio.

Virtual programs provide a unique opportunity for students to interact with an environment and interact with the program specialist in a novel way, all without leaving their school. Distance learning technology provides for learning that caters to the tastes and preferences of a greater number of individual students (Ayers 1998). Because these programs are unique and interactive, they have been shown to be especially good for students who lack learning motivation (Ba and Keisch 2004). Benefits of these programs are potentially significant, but have not been measured through quantitative evaluation. Testing of informal education experiences is limited because the traditional model employed in regular classroom research is inadequate to measure the effectiveness of programs outside the classroom (Hyman 1976; and Ramey-Gassert, et Al. 1990). Educational potential of informal education facilities is well recognized (Boyd 1990; Semper 1990; and Rennie & McClafferty 1995), but, as many reviewers point out, a majority of the literature that promotes informal learning programs is based on little more than anecdotal evidence (Ramey-Gassert, et al. 1990). Informal education facilities will more often divert funds to creation of programs and facilities than to evaluation (Chen 1994). To date, what is lacking is a comparison between educational effectiveness of "virtual" programs and that of on-site programs, particularly in the context of children's science education provided by zoos and aquaria. Documenting program effectiveness provides a vital tool for design and development of future distance learning programs and techniques. There are seven ways to measure educational effectiveness. Yet little empirical evidence comparing different types of educational programming in terms of children's knowledge exists (Tarlton & Ward 2006).

Previous studies have not found a significant difference between traditional and distance learning program effects. Allen et al. (2004) used meta-analysis to assess distance learning impact and found little distinction between teaching methods in regard to performance on tests; with distance learning, students performed only slightly better. However, the authors reviewed only literature dealing specifically with college level courses; their conclusions cannot be validly applied to informal youth education. Similarly, Pool (1996) found no significant difference between the two method's efficacy, but the comparison study focused primarily on non-traditional college students and used satisfaction levels as its basis for conclusions, which, again, cannot be applied to school children. The Seatrek program at Mote Marine Laboratory of Florida conducted a distance learning program evaluation that included observations of students and teachers during programs as well as exit surveys for teachers (Ba and Keisch 2004). That study relied primarily on teachers' opinions of program impacts on students' knowledge and behaviors. Without actually obtaining student opinions or testing for increased knowledge after the programs, the study failed to assess adequately the educational impact of Seatrek's programs.

One study has measured the effectiveness of distance learning programs on middle school children. The Jason Project, which was one of the first to use distance learning technology to help teachers provide real-world, interactive examples and lessons in science, was evaluated by the Center for Children and Technology. Ba *et al.* (2001) used a pre- and posttest design to measure change in inquiry-based science skills, and found that 66% of students made gains after program participation. Although the authors did not test content knowledge, they showed that, through distance learning and virtual tours, significant educational gains could be achieved.

Need for Research

A comprehensive evaluation comparing the two methods for children at an informal education facility, taking into account effectiveness, content, and delivery method, is not available to date. Evaluating the educational benefits of virtual programming could potentially become an important decision-making tool for initiating or continuing these programs at many facilities. Comprehensive studies outlining the educational benefits of these virtual programs could show facility managers that they can increase children's knowledge effectively (Tarlton & Ward 2006). Studies could also show that these educational programs are not worth continued funding and could potentially lead to the demise of virtual field trips.

Study Environment

Within the informal learning environment, efforts have been made to determine participant happiness, visitor interest, visitor behaviors and behavior change. Although it is accepted that aquarium, zoo and museum experiences can play an important role in stimulating interest in scientific processes and phenomenon (Messenger 2000), very few studies have looked at knowledge gained through educational programming. To fulfill mission statements that increasingly include evaluation as a component, it was necessary to have methods that could measure content knowledge derived from informal education programs. Distance learning programs are new and relatively untested, and past studies did not use quantitative methods or pre- and posttests based on content knowledge in the informal environment.

Content knowledge is frequently overlooked as a criterion for informal educational program evaluation. Qualitative methods to measure criteria such as satisfaction and attitudes have become relatively common in the zoo and aquarium industry (Pool 1996; Ba and Keisch 2004). To supplement these measures and to improve program evaluation, knowledge gain should also be measured. Independent facility visitors are difficult to classify as study participants because they are independent of one another and are free to leave at any point, so they may not take the time to complete pre- and posttests. In these cases, exit surveys have been commonly used. Educational program participants are a captive audience, so a constant grouping can be maintained; knowledge gain can be measured through pre- and posttests. Under certain circumstances, it may be possible to monitor this group over an extended period of time. Studies on program effectiveness could be exceedingly valuable to institutions for modifying programming and obtaining funding, as well as fulfilling their mission statements.

CHAPTER 3

METHODS

Study Context & Exhibit Development

The Potter Park Zoo is a small inland facility located in Lansing, Michigan. In the fall of 2003, a committee was formed to discuss design options for a coral reef exhibit to replace a temporary "Lake Victoria" exhibit in the zoo's education facility. Initial participants of the committee were the zoo education curator, the owner and three employees of a local pet store, two Michigan State University professors, three graduate students, the zoo's veterinarian, and three zookeepers. Committee meetings were planned to outline possibilities for the exhibit, animal selection, design and construction. The recent certification of Preuss Animal House of Lansing, Michigan by the Marine Aquarium Council prompted the committee to decide on a conservation-based coral reef exhibit. The zoo desired an exhibit that would be a large-scale simulation of an entire coral reef habitat (Doordan 1995). Three main message components of the exhibit were identified: clownfish rearing, coral reef ecology and conservation. Based on these elements, a rough concept design and content outline for the exhibit were developed and a local muralist was hired to paint and construct the exhibit.

Construction of the exhibit began in summer 2004, with design and construction continuing for the next year. Throughout exhibit planning and construction, central educational themes were outlined and incorporated into animal selection, wall murals, and educational signage. Zoo staff wished this exhibit to follow in the footsteps of other facilities, to be a mutlilayered exhibit catering to different audiences and to be a community resource leading to rich experiences for visitors (Coe 1991). In August 2005, the exhibit opened for public preview. Public opinion was overwhelmingly positive. The exhibit created a highly memorable setting that incorporated sight, sound, smell, and touch within an ambience that affected visitors and their perceptions of the marine environment.

Along with educational themes, consideration also was given to incorporating distance learning technology. A section of the wall mural was selected as a filming backdrop, and Internet protocol (IP) and integrated services digital network (ISDN) ports were made accessible. A Polycom™ video-conferencing unit was donated to the zoo, and a distance learning cart with the necessary equipment to run distance learning programs was built. Equipment included a television, microphone, switchboxes, hub, auxiliary camera, and extra long wires and cables.

Program Development

Curriculum

With the exhibit infrastructure and signage in place, curriculum corresponding to the exhibit was planned. Educational exhibit goals were reviewed and curriculum development began. To meet these goals, the main content outline consisted of the following:

- What is a coral reef?
- How are coral reefs related to Michigan?
- What is coral, and how does it live?
- What is symbiosis?

    - Definition
    - Symbiosis examples in the coral reef.
- What are the values of coral reefs?
    - Natural
    - Environmental
    - Economic
- Why do reefs need protection?
    - Natural impacts
    - Human impacts
- How are we trying to protect coral reefs?
- What can you do to help?

The content outline was then elaborated into a 45-minute educational program aimed at upper elementary and middle school students. Program development took into consideration the learner's need to make quick connections between what they already knew and something novel. (Bitgood et al. 1994). During development, the program was designed to meet Michigan State Curriculum Standards, which guide the educational content for public schools. The 45-minute educational program corresponded with, and provided real world examples for, five Michigan Educational Content Standard Benchmarks (Appendix A). The resulting educational program (Appendix B) was information-packed and interactive, and combined teaching methods to accommodate upper elementary and middle school students. It was also designed so that, as new exhibit portions opened and more funding became available, interactive materials and program related manipulatives could be incorporated.

For this study, school groups were able to participate in traditional programs for the exhibit as well as comparable distance learning virtual programs. The virtual programming delivered the same content as the on-site program, using interactive, mobile video-conferencing equipment. It featured a staff educator who interacted with the class, utilized live aquariums and the exhibit, murals and provided tank-by-tank tours that incorporated behind-the-scenes areas. The program, in both delivery methods, was approximately 45 minutes in duration, designed to provide both an entertaining and a meaningful experience.

Educational Objectives

To assess the impact of individual program content sections, educational objectives were outlined in order to provide measurable milestones for accomplishment. Objectives (Appendix C) covered total knowledge gain, amount of knowledge gain to be expected, and outlined the number of students that learned the content deemed most important. The objectives could then be used in the future to make program and test modifications.

Staff Training

Finally, the zoo's educational staff had to be trained for program delivery. Training sessions were held for volunteer education staff (docents) and the education curator. Sessions were designed to help zoo docents become more comfortable with educating visitors about the coral reef environment. Docents also were trained in the use of distance learning equipment. Training sessions were designed to create a four-person team to conduct distance learning programs, not only in the coral reef exhibit, but also throughout the zoo. The team consisted of an on-camera presenter, remote operator, auxiliary camera operator and a fourth person to obtain materials, contact schools should there be a problem, and to perform other miscellaneous duties.

Instrument Development

Initial Instrument Development and Testing

Pre- and posttests were designed following the main program outline covering five Michigan State Curriculum Standards for 5th through 7th grade students. This was the zoo's primary target audience. As students progress into middle school, there is a void in zoo education programs offered to this age group. The upper elementary and middle school students are on a similar "continuum of Learning" and a test was constructed to measure the knowledge gained by the students at their learning level (Nitko & Brookhart 2007).

Research indicates that a test of 20 to 30 questions is appropriate for upper elementary and middle school students (Melton et al. 1996). For this study, twenty multiple-choice questions were originally written to measure all educational program objectives. Multiple-choice questions were composed of the traditional elements: stem (introductory sentence), distractors (incorrect answer choices), and the keyed alternative (correct answer) (Nitko, & Brookhart 2007). The tests used a combination of direct and indirect assessment questions. Some measured only information recognition; others made students use new information to make decisions and select importance for information they could recall (Nitko & Brookhart 2007). The pilot version of the pretest can be found in Appendix D. Five student groups then participated in the program on a trial basis to assess the test instrument and program delivery. Based on results, both the program and instrument could be revised.

The *Big Zoo Lesson* provided an instrument and program test group. Many teachers of the weeklong in-residence program for elementary classes wanted to incorporate the new coral reef exhibit, and asked to participate in the new education program. Three 5th grade classes volunteered to participate in educational programs and take pre- and posttests as part of their Potter Park Zoo, *Big Zoo Lesson* experience. The three 5th grade groups took the test and commented on design and content. Recommended changes were made to correct of typographical errors and confusion based on poor word choice. Six teachers also were consulted about test appropriateness, difficulty, content and wording to ensure that the test was relevant to user groups.

Following the program and instrument testing period, several test modifications were made (Appendix E). During test modification it was determined that, according to state curriculum standards, the program would be best suited for 7th grade students. One component of modifying the test for 7th graders was expanding the number of items from 20 to 25. The completed 7th grade pretest (Appendix F) includes seven questions that were not in the original test. The questions added are numbers 4, 9, 10, 11, 12, 18, and 19. Each question was derived from an educational objective and evaluated by teachers for appropriateness and relevancy.

The resulting pretest was then reviewed by several teachers individually and determined to be complete and appropriate for the 7th grade audience. Pretest questions were then rearranged in random order to produce a posttest having identical questions. The official posttest can be found in Appendix G.

Pilot Test

A pilot test was scheduled for early spring semester 2006. Seventh grade teachers from Shiawassee, Ingham, Clinton and Eaton Counties were invited to participate at no cost. Only one teacher responded with genuine interest, but, due to budget constraints and logistics, was unable to participate in the pilot study. This reaffirmed the need for distance education programs, to provide a cost- and time-effective option for teachers. Because the student groups for this study were already in place, and their dates approaching, it was decided that a pilot test using 5th graders would be used as a replacement.

One 5th grade class from Laingsburg Elementary School in Laingsburg, Michigan participated in the *Big Zoo Lesson* and in the coral reef educational program. The class took the pretest the day before the on-site educational program and the posttest the day following the program. Five teachers and their students agreed that test length and content were appropriate.

Results of Pilot Test

The pilot test was used to calculate question discrimination indices to determine if any questions should be removed. A discrimination index measures how well each item of the test discriminates between high and low scoring students. Calculations are based on two sub-groups, high-scorers (six top scoring students) and low-scorers (6 lowest scoring students), using the following equation (Bloom 1981):

$$\text{Discrimination Index} = \frac{\begin{array}{c}\text{\# of students}\\ \text{getting item right}\\ \text{in high-scorers}\end{array} - \begin{array}{c}\text{\# of students}\\ \text{getting item right}\\ \text{in low- scorers}\end{array}}{\begin{array}{c}\text{\# of students in}\\ \text{each group (6)}\end{array}}$$

Any instrument item with a discrimination index less than 0.2 was excluded because it lacked the ability to discriminate between high and low scoring students. Up to three items could be excluded, leaving a test with 22 items that were considered valid.

No questions scored a discrimination index of less than 0.2 on the posttest (Table 1). Thus, all questions were satisfactory and would remain in the final test versions. Question six had a perfect discrimination score of 1.0. Four other questions had a discrimination index of 0.8, while nine more had an index of 0.7. Overall, the average discrimination for the test was 0.6, which is sufficiently above the 0.2 cut-off. Only five questions scored below the 0.5 discrimination level, but all were 0.2 or above (Table 1).

Table 1: Discrimination values for pilot study pretest questions.

Question	Discrimination Index
1	0.3
2	0.8
3	0.7
4	0.7
5	0.7
6	1.0
7	0.7
8	0.5
9	0.8
10	0.7
11	0.7
12	0.3
13	0.8
14	0.8
15	0.5
16	0.7
17	0.3
18	0.5
19	0.5
20	0.7
21	0.5
22	0.5
23	0.3
24	0.7
25	0.2
Average Discrimination	**0.6**

Content validity was determined by having teachers and zoo education staff scrutinize the test instrument. Several criteria for validity were included: "Did the instrument emphasize what you taught?" "Does the instrument represent school curriculum content?" "Does the instrument represent current content within the field?" and "Does the instrument contain content worth learning?" (Nitko, & Brookhart 2007). For all of these measures, it was found that the test was valid for a 7th grade audience.

With a finalized test in place, one more component of the study was designed. To ensure that the program and test were appropriate for 5th through 8th grade students, a qualitative teacher assessment was developed. Utilizing both quantitative and qualitative data could provide information that can possibly be used for major decisions in the future (Nitko, & Brookhart 2007). Knowledge gain scores alone provide data on the effectiveness of a program, while teacher feedback provides information about satisfaction, demographics, difficulties, and strengths of the program that could be important to future program and test adjustments. Therefore, qualitative data about teachers' opinions about the program and test were collected with a lengthy four-page questionnaire (Appendix H). Teachers were asked about student demographics, their personal teaching experience, technology use (both personal and in their classes), program materials and logistics, test content, length and administration, program effectiveness and student attitudes. They also were asked to rate their level of agreement and disagreement with several statements about program appropriateness, willingness to participate again, and comfort with the program format.

To comply with Michigan State University Institute Review Board standards, consent and assent forms (Appendix I) were developed. Teachers and principals signed consent forms for their classes to participate and for the teachers to complete the questionnaire. Students signed an assent form showing their willingness and commitment to the study. The parents/guardians of the students also completed consent forms for their children to participate.

Study Methods

Target Population & Sample Selection

To measure relative effectiveness of two informal education programs, several factors were taken into account. The target study population was identified as 5th – 8th grade science classes, and through Michigan State Curriculum Standards it was determined that the 7th grade audience would be best suited for the coral reef program content. The primary target of distance learning programs were schools just outside the usual county-wide travel limits of zoo visitors, so participants were selected from schools within a three-county radius of the zoo that had distance learning capabilities.

Sample

Perry Middle School in Perry, Michigan was the first to register. Statistical analysis to determine appropriate sample size showed that a sample size of 300 students was needed to get significance with a power of 0.8, $p<0.05$. Perry Middle School had a 7th grade class of approximately 170 students, which fell short of the 300 needed, so solicitation of more schools to participate began.

Through Michigan county regional education service districts (R.E.S.D.s) a list was compiled of all school districts within a four-county radius of the zoo that had distance learning capabilities. Eaton, Shiawassee, Clinton and Ingham Counties each had school districts having distance learning facilities within middle school walking distance. An email address list was compiled of all seventh grade science teachers from school websites. An email was sent to all teachers, inviting them to participate in the study at no cost. Three responses were received, but none represented schools that were viable candidates due to logistical issues. A second email was sent out with a mailing. A program marketing flyer was designed and mailed with a letter of invitation to each of the remaining teachers and their principals. Two schools responded to the flyers, Laingsburg Middle School and St. Johns Middle School. Logistical issues prevented Laingsburg from committing; therefore, St. Johns middle school 7th grade students were accepted.

Research Design

A quasi-experimental method was selected for this study (Figure 1). One reason was to control as many extraneous variables as possible. Using a two-block sampling helped to reduce random error (Langbein 1980). Two schools were used, and each was split between control, virtual and on-site groups. Using a quasi-experimental method to compare two treatments for two different blocks was used to compare the relative effectiveness of virtual and on-site programs.

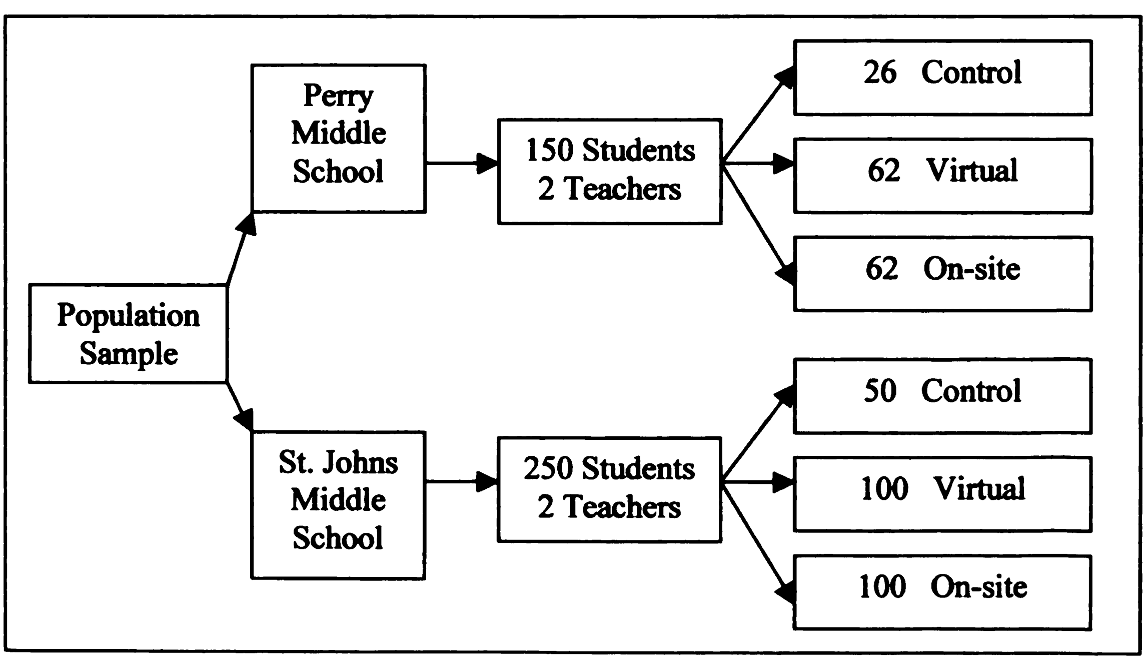
Figure 1: Quasi-experimental design model

$$\begin{array}{ccc} O & & O \\ O & X_1 & O \\ O & X_2 & O \end{array}$$

Administration of Programs and Tests

Each school's teachers and students were then divided to participate in the virtual and on-site programs. Each school also had a control group to measure the "test effect", to determine whether or not students were learning from the pretest itself. Both schools have two science teachers. After randomly assigning class hours into the control group, one teacher from each school was randomly assigned to have their students participate in the virtual program (the virtual group), and the other was assigned to participate in the on-site programs (the on-site group) (Figure 2). Because of non-equivalent student numbers in Perry classrooms, a combination of classes was used for the virtual programs to create evenly-sized study groups. After the students were divided into appropriate groups, teachers explained the study according to the researcher's specifications, and consent forms for the parents to sign and assent forms for the students were distributed.

Figure 2: Study sample, divided into control, virtual and on-site programs groups by school.



Four teachers participated in the study, and each completed the teacher questionnaire, following the posttest, to provide qualitative data to explain some of the quantitative results.

To be consistent between the two schools, as well as accommodate school schedules and exhibit programming schedules, a five-day time line was established for students to take the pretest (Table 2), attend their educational program (either virtual or on-site) and take the posttest.

Table 2: Test administration timeline.

Week	Day	Activity
Week 1	Monday	Control pretest administered
	Friday	Control posttest administered Virtual pretest administered On-site pretest administered
Week 2	Monday	Virtual programs conducted
	Tuesday	On-site programs conducted
	Wednesday	Virtual posttest administered On-site posttest administered

The Perry classes adhered to the timeline, while St. Johns had to modify due to a holiday. For St. Johns, the control posttest, virtual and on-site pretests were given on Thursday instead of Friday. Control groups followed a timeline that would not allow the possibility of students mistakenly attending a program. This helped to ensure that the control pre- and posttests were measuring test effect.

Tests were administered during the students' regular science class period. Teachers administered pre- and posttests with the following guidelines:

- students put their assigned student number on the test paper as the test identifier, along with class hour, teacher's name and program type;
- students' names were not written on the test;
- students tried their best to answer every question;
- students took all the time they needed to complete the test;
- during the week timeframe students were instructed not to seek out answers to test questions.

Pretests and posttests were then compiled by class period and placed in envelopes for collection by the researcher.

Virtual programs were conducted for each school on the Monday following pretest administration. Due to room size constraints, programs were done by class hour. Perry had three class hours participate in each type of program at separate times. St. Johns had four class hours participate in each program. Teachers were on hand during programs for classroom maintenance, and to repeat questions if necessary during programs.

For the Perry programs, the Shiawassee County RESD connected to the zoo with Integrated Services Digital Network or ISDN (a high speed internet connection over multiple traditional phone lines), and then to the Perry distance learning classroom through a bridge (a digital platform that allows multiple sites to connect at high internet speeds, and also allows ISDN to connect with internet protocol sites). For the St. Johns groups, the zoo dialed into the school's distance learning classroom using Internet Protocol (IP). Connections were left running between classes to ensure a stable connection throughout the programs. No dropped Internet signals occurred during any educational programs.

Connections, packet rate (the level at which video and audio information was being transferred between sites), and sound quality remained constant throughout programs and were comparable for both school groups. The researcher functioned as both the on-site and virtual program presenter. The same program outline, timeframe, manipulatives (interactive visuals, examples and objects), camera work, and cameraperson were used for all virtual programs, for both Perry and St. Johns classes to reduce latent variables.

Data Analysis

Test Grading

Tests were administered and collected by the teachers, who then placed them in labeled envelopes for collection by the investigator. A test key and grading procedures were developed. A team of five undergraduate volunteer research assistants helped the investigator grade all exams from both schools. All assistants followed the same grading guidelines. Following grading, the investigator randomly spot-checked four tests per class to ensure grading accuracy and consistency.

Data Entry

Each test was coded by school, teacher, class hour, student number and pre/posttest. Each question response was entered by letter choice (1=a, 2=b, 3=c, 4=d, 5=e) and was also entered by conversion as correct or incorrect (1=correct, 0=incorrect). The correct/incorrect columns were summed by student, to create the pre- and posttest totals. The totals were then subtracted to create a knowledge gain column (posttest total – pretest total) representing the knowledge gained by each student.

After checking for outliers and errors, the final test population consisted of 376 students, with 77 in the control group, 133 in the virtual group, and 166 in the on-site groups (Table 3). Overall, 146 students participated from Perry, with 50 in the virtual programs, 69 in the on-site programs, and 27 in the control group. From St. Johns, 83 participated in the virtual program, 97 participated in the on-site program, and 50 in the control group, for a total of 230 students.

Table 3: Number of students participating.

Program Type	Perry	St. Johns	Total
Virtual	50	83	**133**
On-site	69	97	**166**
Control	27	50	**77**
Total	**146**	**230**	**376**

Some students within all groups took only one test due to absences. These data points were included in analyses that were relevant; such as in mean scores for pretest knowledge gain, all pretests were considered, even if the student had not completed the posttest. Overall there were 353 valid pretests, 349 posttests, and 326 knowledge gain scores. A total of 50 students did not complete both tests to create a valid knowledge gain score.

Discrimination, Difficulty and Reliability Analysis

Discrimination values for test items were analyzed using all respondents in the final study. All questions had a discrimination index of 0.2 or higher when rounded (Table 4). Discrimination values were averaged for each school and then for all respondents combined.

Table 4: Average discrimination values for pretest questions for Perry, St. Johns and overall averages.

Question	Perry	St. Johns	Average
1	0.33	0.17	**0.25**
2	0.22	0.33	**0.28**
3	0.17	0.17	**0.17**
4	0.42	0.23	**0.32**
5	0.28	0.29	**0.28**
6	0.42	0.31	**0.36**
7	0.39	0.21	**0.30**
8	0.39	0.54	**0.47**
9	0.36	0.44	**0.40**
10	0.53	0.33	**0.43**
11	0.33	0.58	**0.46**
12	0.28	0.48	**0.38**
13	0.25	0.33	**0.29**
14	0.39	0.29	**0.34**
15	0.39	0.19	**0.29**
16	0.28	0.27	**0.27**
17	0.44	0.23	**0.34**
18	0.36	0.46	**0.41**
19	0.31	0.17	**0.24**
20	0.61	0.58	**0.60**
21	0.22	0.17	**0.19**
22	0.53	0.40	**0.46**
23	0.22	0.44	**0.33**
24	0.17	0.33	**0.25**
25	0.36	0.50	**0.43**
		Average Discrimination	**0.3**

Difficulty values for all questions combined averaged 78.3. While this value was slightly higher than the traditionally accepted value of 70, in the context of this test instrument, it was deemed acceptable. The test had a slightly higher difficulty value for 7th graders, indicating that the questions were slightly easier for this group than for 5th graders. It is expected that values would be lower for 7th grade groups because they are at a higher learning level. At lower grade levels, a discrimination index would more accurately show the difference between low and high scoring students than it would with 7th grade students. In the context of the test instrument and the scope of the program, a range of discrimination should be seen, as in this case, to accommodate the entire age range.

To test the degree to which students' results remained consistent over repeated test administrations (Nitko, Brookhart 2007), reliability was assessed by Cronbach's Alpha. For the test instruments, a reliability of 0.599 was found. While this is below 0.7, the traditionally accepted value, in this case the 0.599 value was accepted as reliable because each item had a five item scale, and the test had only 25 questions (CSTAT, 2006). No one question had a reliability score that significantly lowered the Cronbach's Alpha enough to be excluded.

CHAPTER 4

RESULTS

Based on the Kolmogorov-Smirnov statistic to assess normality (how well data approximates a normal bell-shaped distribution of scores), it was found that all pretest, posttest and knowledge gain score distributions violated the assumption of normality. All subsequent tests were selected on this premise and appropriate post hoc tests were conducted to accommodate the non-normal data. No extreme outliers were found in the data sample, and all cases were included in further analysis.

Table 5: Mean knowledge gain by program type

Knowledge Gain		
Program Type	**Mean**	**N**
Control	-1.11	66
Virtual	7.27	115
On-site	7.22	145
	Total	**326**

Means for all program types were analyzed and determined to be appropriate and accurate (Table 5). A one-way analysis of variance was used to evaluate differences in knowledge gain scores between the control, virtual, and on-site groups. Both virtual and on-site groups differed significantly in their knowledge scores compared with the control group [$F(2, 323) = 157.588$, $p<0.01$]. Post-hoc comparisons using the Tukey HSD test indicated that both virtual and on-site groups had a significantly higher increase in knowledge than the control groups.

A paired t-test was used to determine significant differences between pre- and posttest scores for all groups. A significance value of $p< 0.001$ was found for

all groups, indicating a significant difference in test scores for all program types

(Table 6).

Table 6: Paired Sample t-test for knowledge gain Between Pretest and Posttest for all Subjects

Program Type	Pretest Mean	Posttest Mean	Knowledge Gain Mean	Std. Dev.	df	t	p
Control (n=66)	12.67	11.56	-1.106	4.170			
Virtual (n=115)	11.84	19.02	7.270	3.414	114	22.835	<0.001
On-site (n=145)	12.69	19.92	7.221	3.006	144	28.928	<0.001

An independent t-test was used to determine if there was a significant difference between knowledge gain scores of the virtual and on-site groups. A probability of 0.903 was found, indicating there is no significant difference between groups in knowledge gain.

A two-way between-groups ANOVA was conducted to explore the impact of school and program type on knowledge gain scores (Table 7). There was a significant main effect for program type with a large effect size (partial eta squared= 0.472). Post Hoc comparisons using the Tukey HSD test confirmed that the control group was significantly different from both the virtual and on-site groups (Table 6). The main effect for school and the interaction effect were not significant.

Table 7: Two-way ANOVA for program type and school.

Source	Df	F	eta-squared	p
School	1	1.184	0.004	0.277
Program Type	2	143.281	0.472	0.000
Interaction	2	0.678	0.004	0.508
Within subject error	320			

Teacher Questionnaire Responses

Four teachers completed the teacher questionnaire. All teachers had similar teaching, technology and ethnic backgrounds. All four teachers prepared their students in the same way, introducing the project and tests, but using no pre- or post-activities about coral reefs. Teachers agreed that preparations and materials provided by the zoo staff were helpful in conducting the program experience for their students. All teachers also agreed that the test was appropriate in length and difficulty for their students, and that the test itself provided a pre-activity that helped direct the students' attention so "they knew what to listen for," and "gave them a chance to hear the terms before they were put in context."

Teachers were asked to rate their experience as well as their perceptions of their students' experiences on a five-point Likert scale (Likert 1932), with 1=Strongly Disagree and 5=Strongly Agree. They were also given the option of "Not Applicable". All teachers similarly ranked each item, as can be seen in Table 8. Teachers were relatively neutral about statements regarding interaction and hands-on components. One teacher, participating in the virtual programs, indicated a strong need for more interactive components. Responses on content, entertainment value, program innovation and effectiveness were ranked similarly. None of the responses indicates that any elements of either program needed modification.

Table 8: Average rank of statements on 5-point Likert Scale. 1= Strongly disagree, 2=Somewhat disagree, 3=No opinion, 4=Somewhat agree, 5=Strongly agree.

		Virtual		On-site	
Question	**Statement**	**Perry n=1**	**St. Johns n=1**	**Perry n=1**	**St. Johns n=1**
20	Most of the students really enjoyed the program	5	5	5	5
21	The program was a unique learning experience	5	5	5	4
22	The interactive components helped my students to be involved	5	5	5	4
24	Real world examples were clearly presented	5	5	5	5
25	Students felt involved in something important outside the classroom	5	3	5	4
26	The students felt the programs had a high educational value	5	3	5	4
27	The program motivated students to seek out more information	2	4	4	3
28	My students enjoyed the content of the program	2	5	5	4
29	The program was effective for less motivated students	4	4	5	5
30	My students learned about the coral reef environment	5	5	5	4
31	My students learned about all the organisms that live in a coral reef	4	4	4	4
32	I would like to participate in more zoo programs in the future	4	5	5	4
33	Sometimes it was hard to hear the speaker	1	3	1	1
34	The material was too hard for students to understand	1	2	1	1
35	There needs to be more interaction during the program	1	4	4	4
36	There needs to be more hands-on activities	2	3	5	4
37	Students felt there was too much information covered	1	2	1	4
38	Students felt that the program was entertaining but had little educational value	1	3	1	2
39	Only my very smart students gained significantly from the program	1	2	1	2
40	I am not convinced that my students will want to learn more about this topic	2	2	1	2
41	The program was not new of innovative	1	3	1	2
42	I am afraid that my slower students did not follow the program	1	2	1	2
43	I would like to participated in other future programs of this type	1	1	1	2

CHAPTER 5

CONCLUSIONS & DISCUSSION

Study Results

Three primary conclusions were drawn from this study. First, participation in the educational programming increased knowledge from pretest to posttest for both the virtual and on-site groups. Second, there was no significant difference in the knowledge gain from the virtual and on-site programs. Third, there was no difference between schools in terms of the mean knowledge gain.

This study rejected the alternative hypothesis that "evaluation of the "Clownfish, Corals and Conservation" educational programming will show that distance learning "virtual" programs are more effective than on-site programs in increasing knowledge scores" In addition, the specific goals of the study were met. The program was effective in increasing knowledge of participants similarly between delivery methods, indicating the program could be effectively adapted to virtual program delivery. No significant difference in knowledge gain scores between program types indicates that virtual and on-site delivery methods are equally effective for this program.

Teacher perceptions reaffirmed knowledge gain results. Teachers agreed with statements that their students enjoyed and gained valuable knowledge from the programs. Teachers were satisfied and had no suggestions about the program and their on-site or virtual field trip experience. Statements about the interactivity and hands-on components of the program were rated neutrally or affirmatively by the teachers, possibly indicating that more of these elements should be incorporated into the program.

Some results indicated that students had pre-existing content misconceptions. On pretest questions 4, 8, 9, 10, 14, and 25, the majority of students chose distractors (incorrect answers) rather than the keyed alternative (correct answers). This shows that the content tested by these questions was either unknown to the students, randomly guessed, or had at some point learned misinformation. These six questions were highly specific to material on coral reefs as presented in the program. Why students would have misconceptions about content is worth considering.

Although potential misconceptions were shown for six pretest questions, only one posttest question indicated that the program had not removed all misconceptions. On pretest question number 8, a larger percent of students choose a distractor over the keyed alternative. This question asks students to recall the reasons why coral reefs are important. The correct answer was "all of the above", but more students selected "coral reefs are a home for many species". This limited understanding could be due to an oversight in the program content, lack of reinforcement, or students' selection of an answer before reading all of the options. Further study about the distractors chosen could give diagnostic insight to student misconception as well as test weaknesses (Nitko & Brookhart, 2007). Question 8 is a higher-level thinking question. Students were asked not only to recognize the information, but also to synthesize and select more than one correct alternative.

Research Implications

This study provides a model that informal education facilities can follow to complete a quantitative evaluation of their educational program. Using a quasi-experimental design, and a sample size of only 300, a facility could assess relative program effectiveness. Careful thought must be given to program design to make content comparable, and consideration should be given to research design to minimize outside influences and to get a representative sample of the target population.

This evaluation assessed students' recognition of information, relying on them to identify material covered in the program. Recognition questions can yield significant results if learning is targeted at the recognition level. When testing for application of knowledge, recognition questions would need to be combined with recall and application questions to yield significant results in most cases (Loman and Mayer, 1983). In this study, learning was measured primarily by recognition. Based on recognition results regarding knowledge gain adequately show significant program effectiveness. Program design must be developed around educational themes, and tests must measure learning for each individual program objective.

Recognition gains could be used as a baseline for future research. Understanding what and how students are learning can begin to show what material they relate to and how connections can be made to change attitudes and conservation behavior in future studies.

Implications for Informal Learning Institutions

Measuring the effectiveness of distance learning programs can be a valuable tool for zoos, aquaria and museums. Facilities that market their programs need to demonstrate to schools and teachers the program's importance, its relation to state curriculum standards, and educational effectiveness. With the continuation and proliferation of virtual and on-site programs, schools could then select the program(s) that fit their financial resources and curriculum goals.

Promoting distance learning programs is difficult. They must be shown to be equally as effective as on-site programs. Until this study, no one has shown that distance learning virtual programs for children can be as educationally effective as traditional programs in the informal learning environment. With three-fourths of United States school districts planning to offer or expand their distance learning programs (eSchool News 2005), effective programs can, after mutual initial investment, be a cost effective tool to provide learning across great distances.

Virtual programs also can provide a new method to generate revenue for a facility from groups that normally would not visit. Initial financial burdens of virtual programs can be justified if that program performs educationally as well as on-site programs. Potter Park Zoo used this evaluation as a means to support grant proposals to continue future funding of the distance learning program. These programs may not completely fund themselves until there is a large enough program base. By showing the programs are just as effective as on-site, the decisions regarding continuing funding become easier for the facility, and they also can support proposals for grant funding.

Funds for field trips are decreasing in many school districts. Virtual programs provide a viable alternative that can be cost effective. At the same time, for zoos and aquariums, the income from virtual programs could replace revenue lost due to decreased field trips while also providing the educational experience for those groups through technology. Results of this study show that comparable distance learning and on-site programs can be created that educationally will show no difference in knowledge gain. The choice of program type then becomes one based on the type of experience teachers want their students to receive and that would be more cost-effective in their situation.

Field trip funding may not always be the limiting factor. In the future more funding may become available, and the reasons for use of distance learning virtual programs may need to shift. In this instance, programs could be used as advanced organizers for teachers to prepare students for their on-site field trips. Virtual programs also can be used as pre- and post-activities. This would expand the field trip experience from one session to multiple, thereby increasing the "real world" learning experience and providing ample opportunities to increase student learning through multiple learning and teaching styles. Virtual programs also can be used as a teacher preparation tool. Classes could be held to prepare teachers to conduct pre-activities and to provide an effective field trip experience. Virtual programs could also be used as part of teacher development days to provide new and relevant examples that they could then use in their classrooms throughout the year. Opportunities to use this equipment to provide learning experiences for many groups throughout large geographic areas are limitless.

Showing that virtual programs are equally effective in transmitting knowledge as on-site programs could create an unintended consequence. If different program formats have comparable educational inputs, why should school groups ever come to the zoo again? Distance learning programs should never be considered the same as the real thing. Knowledge gain is only one program outcome. Getting students out in the zoo, interacting with their 5 senses, cannot be duplicated through tele-videoconferencing. Marketing programs to completely replace on-site trips would be a mistake. The niche for virtual programs is that they would provide an opportunity for students who would never have a field trip opportunity to visit the zoo. Virtual programs provide at least the educational portion of the field trip and a portion of the full experience. A virtual experience could provide lasting connections for children who would normally never interact with a zoo or aquarium educator. Programs could also provide inspiration for students to become first time, on-site visitors, thereby increasing zoo and aquarium visitor numbers. In these situations, virtual programs could be invaluable.

Conclusions

In the zoo and aquarium industry, long gone are the days of square, characterless cages and limited signage. Since the 1970s, facilities have moved away from using glass barriers, wires and painted exhibits in favor of more realistic settings for the animals (Turkowski 1972). At that time, filmstrips and public lectures were commonly used for the limited education programs available (Turkowski 1972). Facilities now make exhibits more interesting, realistic and participatory, engaging all the senses to increase learning (Ayers 1998).

Education departments and programs have followed suit. They used to be neglected due to insufficient funds and lack of interest by zoo stakeholders (Turkowski 1972), but are now greatly expanded. Professional organizations such as the Association of Zoos and Aquariums now have strict requirements about the minimum size of the education staff and the programs offered, for accreditation by the organization. This has encouraged many facilities to expand their education departments, sometimes to include distance learning.

Distance learning technology has engendered concerns. Many people involved in this study raised questions about cost, effectiveness, and a possible trend of school groups abandoning the traditional field trip model. These are all valid concerns. Distance learning should not be viewed as a replacement, but as a new opportunity to reach audiences that would never be able to participate in an educational program at the facility otherwise. This study has shown that, with proper planning and design, virtual programs can be as educationally effective as traditional on-site programs.

Limitations

This study has limitations. Results apply only to seventh grade participants of the two schools involved, as well as to one educational program. Not all programs will be as readily adaptable to the distance learning format. Some require more movement or highly interactive methods that can not be accommodated by video-teleconferencing. Not all student groups will be able to achieve the high level of learning seen in this study. Volunteer docents that are not experts in the field may have trouble answering questions as well as trained educators. Special education groups as well as emotionally impaired groups will have to be given modified programs to achieve similar results. Technology is not consistent among schools and facilities, which can make virtual programming impossible. Compatible systems must be in place to implement virtual programs, to avoid technological problems.

Recommendations for Future Research

Future research must be developed with consideration for stakeholders' needs, assumptions, and expectations. Consideration must also be given to district, state and national curriculum standards to ensure the project design will produce its intended effects. This can be done through pilot testing. A needs assessment could be used before exhibit and program development to achieve an adequate understanding of the target audience. This will create a knowledge base that will ensure the design and development effort will match the facilities' as well as the users' goals (Crane 1994).

Future studies could compare programs about different topics to determine which formats and topics are best suited to virtual programming. To develop this study further, higher thinking skills could be measured, taking into account not just recognition, but also recall and synthesis skills, which become increasingly important at higher grade levels. The effects of pre- and post-activities could also be measured in conjunction with program effectiveness. This study provides a stepping-stone for the industry to expand the distance learning field as well as the evaluation of its programs. Follow-up studies of virtual participants could determine the increase and/or decrease of on-site visitations.

The ability to use this technology in many ways provides a new field for educational research. If programs were to be used on outdoor nature trails, rather than indoor exhibits, the effectiveness may differ. Using programs for teacher development and pre- and post-activities would also create a need for research on impacts of these applications. Not only would new uses need to be evaluated, but they could also provide stepping-stones for research on changes in participant's attitudes and behaviors.

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APPENDICES

APPENDIX

A

Appendix A

Michigan State Curriculum Benchmarks included in Program

- Science Strand III, Content Standard 5 (Ecosystems), Benchmark 1
  - Describe common patterns of relationships among populations.
    - Mutualism, parasitism, predator, prey, competition
- Science Strand III, Content Standard 5 (Ecosystems), Benchmark 2
  - Describe how organisms acquire energy directly or indirectly from sunlight.
    - Producers, consumers, photosynthesis, sunlight, plants, food web
- Science Strand III, Content Standard 5 (Ecosystems), Benchmark 6
  - Describe ways in which humans alter the environment
    - Resource use, solid waste, toxic waste, biodiversity
- Science Strand V, Content Standard 1 (The Geosphere), Benchmark 4
  - Explain how rocks and fossils are used to understand the age and geologic history of earth
    - Fossils, rock layers, timelines
- Science Strand V, Content Standard 1(The Geosphere), Benchmark 3
  - Explain how rocks are broken down, how soil is formed and how surface features change.
    - Erosion by glaciers.

APPENDIX

B

Appendix B

"Clownfish, Corals and Conservation" Program Outline

What is a coral reef?

Plant and Animal communities (ecosystem) –

Coral reefs are the "rainforests" of the ocean.

They are the most biologically diverse ecosystems of the sea.

> **Video Clip**
> **Tank overview**

Location – Coral reefs are located worldwide in tropical seas. In the US they are found in Hawaii and the Florida Keys.

Biodiversity – Coral reefs make up only 1% of the ocean, but have 25% of the species. If the whole ocean was a gallon milk jug, coral reefs would fit into a teaspoon. Coral reefs have an amazing array of plants, corals, invertebrates, fish and many other species. Fish are the most widely varying group on the planet, and just one fish family has over 1600 species (gobies).

> **Manipulative**
> **Milk jug and spoon**

Habitat Requirements – Coral reefs can grow only in water that is warm, salty and shallow. They require lots of sunlight and nutrients.

What does coral have to do with Michigan?

Our state stone is actually a fossilized coral. Petoskey Stones are what remain of coral reefs that covered parts

> **Manipulative**
> **Coral and Petoskey picture**

of nine states around Michigan, 350 million years ago (MI, IL, IN, PA, OH, KY, NY, WV, MD). Michigan used to be near the equator and covered in a warm, tropical sea. Through plate tectonics, we shifted to our current position, where glaciers carved up the reefs, creating the Petoskey stones we find today.

What is coral?

Characteristics – Coral is actually a tiny animal called a polyp. Hundreds of identical polyps live together in what is called a colony (or coral head).

Video Clip
Polyps and tentacles

- Corals have tentacles that they use to get food - plankton, and even tiny fish. (Have students stick arms up in the air. They are each a coral polyp with their 2 tentacles). At the end of each tentacle is a stinging cell called a nematocyst. It is like a tiny harpoon that can stun prey. They will also use it for protection.
- Corals have symbiotic algae that live inside their tissue called Zooxanthellae. The corals give the algae protection, carbon dioxide and wastes so they can carry out photosynthesis. The algae in return provide the coral with its color (a kind of sunscreen), food and oxygen.

Manipulative
Zooxanthellae picture

Hard corals – Create a skeleton made out of calcium carbonate (chalk). When they are threatened, they will retract into their skeletons for protection. Hard corals build the structure of coral reefs.

Video Clip
Hard vs soft corals

Soft corals – Do not create a skeleton, but do have spicules that give them some support and protection. (They are not fun for fish to eat, kind of like fiberglass.)

Relatives – Corals are cousins with anemones and sea jellies (not jelly fish…they are not fish). They all have very similar structures, they just live differently, with jellies drifting, anemones attaching to the bottom, and corals attaching to the bottom but having skeletons and living in a colony.

Video Clip
Anemone

Symbiosis

There are many species on a coral reef that are symbiotic.

Coral polyps and zooxanthellae

Watchman Goby and Pistol Shrimp –

Live together in a tunnel that the blind shrimp digs. The Goby acts as a lookout.

Video Clip
goby/shrimp
cleaner shrimp

Cleaner shrimp and fish – Cleaner shrimp eat the dead scales and parasites off of fish.

Clownfish

> **Video Clip**
> **Clownfish in the anemone**

Symbiosis – Clownfish have a symbiotic relationship with anemones. They constantly rub against the anemone to coat themselves in slime, so the anemone will not sting them. The clownfish bring food back to the anemone and will clean up scraps and eat dead tentacles. The anemone provides protection (with its nematocysts), and gives the clownfish a home.

> **Video Clip**
> **UW lab and babies**

Propagation – PPZ is raising baby clownfish so that fewer are taken from coral reefs. This helps protect coral reefs without stopping the sale of reef fish in pet stores.

Value of reefs

Natural value – Coral reefs are beautiful and rare ecosystems. Tons of organisms live in a tiny space.

Environmental value – Reefs protect shorelines from storm and wave damage as well as erosion.

Economic value – Reefs provide the only income to many people in island nations. They provide food, medicine, products helpful to humans, animals for the aquarium trade, recreation and tourism money. Those, along with the money saved by their coastal protection, are worth about $375 billion dollars per year.

Why do reefs need protection?

30% of reefs worldwide are already damaged. By 2050, over 60% could be damaged beyond repair.

Natural impacts – Global warming is changing ocean temperatures. Warmer waters cause coral bleaching, in which the coral will actually expel their zooxanthellae. Hurricanes and storms also break up the reef and can kill some reef species.

Human impacts – Anchor damage, boat groundings, propeller damage, and divers and snorkelers kicking or taking coral. Water quality also is impacted by runoff of fertilizers, pesticides and sewage, and by discharge from cruise ships. Marine debris also has an effect on many reef organisms. Nets tangle and strangle corals, and dolphins and turtles eat plastic bags after mistaking them for sea jellies. Traditional Chinese medicine, shark finning, oil spills and bombing ranges are also very destructive human impacts.

Manipulative
Debris/nets

Destructive fishing – Dynamite fishing is used in many parts of the world. Sticks of dynamite are thrown overboard and fish are stunned or killed and float to the surface for easy collection. Cyanide fishing is a common way to collect fish for the aquarium trade. Divers squirt cyanide into hiding places and fish are stunned for easy collection. Almost 80% of the fish die from this method.

Video Clip
Diver mural

What is being done?

Marine protected areas restrict recreational and fishing activities to harm reefs less. Education programs target fishermen, snorkelers and divers. Artificial reefs provide new habitat for many species. MAC (Marine Aquarium Council) certifies fishermen, wholesalers and pet stores in sustainable methods of fish collection. Preuss Animal House was the first ever MAC-certified store.

<u>**Video Clip**</u>
Artificial wreck

What can you do?

Be careful when diving and snorkeling.

Conserve energy and water.

Reduce the use of pesticides and fertilizers.

Compost and recycle.

Save gas.

Be an informed consumer- buy only MAC-certified coral reef animals.

APPENDIX

C

Appendix C

Educational Objectives

- 75% of students will be able to correctly answer 20 of 25 posttest questions following the program.
- 75% of students will increase their test score by 2 or more following the program.
- 35% of students will increase their scores by 5 or more. (Questions: 2,4)
- Following the program, 60% of students will be able to clearly define what coral is and how it lives. (Questions: 8-12, 14)
- Following the program, 60% of students will be able to define symbiosis and give two examples in the coral reef. (Questions: 5, 7, 13)
- Following the program, 75% of students will be able to rule out factors not affecting coral reefs. (Question: 21)
- Following the program, 75% of students will be able to choose actions that they can do to help coral reefs. (Question: 25).

APPENDIX

D

Appendix D

Pilot Pretest

Clownfish, Corals and Conservation
Potter Park Zoo

Name________________________

Pretest

Circle the best answer

1. Coral reefs have many different animals and plants in a small area. They are like the _________ of the ocean.
    a. Deserts
    b. Oceans
    c. Rainforests
    d. Mountains

2. Coral reefs need this type of water in order to grow.
    a. Warm, shallow, salty
    b. Cold, dark, deep
    c. Any kind
    d. Freshwater, lots of nutrients

3. There are 3 main kinds of reefs: fringing, atolls and
    a. Spectacular
    b. Barrier
    c. Spotted
    d. Outlying

4. Coral reefs…
    a. Are a very large portion of the ocean
    b. Are not important to the ocean
    c. Have very few animals and plants
    d. Are a tiny part of the ocean with lots of animals

5. Coral reefs require sunlight because
    a. Corals have a symbiotic algae that need sunlight
    b. They are afraid of the dark
    c. The animals need sunlight to grow
    d. It makes fish brightly colored

6. Corals used to grow in Michigan, today we find them as…
    a. Jewelry
    b. Plants
    c. Extinct
    d. Petoskey stones

7. Corals have been around
    a. Only ten years
    b. Over 350 million years
    c. Since the ice age
    d. Since the civil war

8. Coral is
    a. An animal
    b. A plant
    c. A rock
    d. A mineral

9. Symbiosis is…
    a. When a cell splits
    b. When two organisms live together
    c. A kind of plant
    d. Making a clone

10. Corals can reproduce by…
    a. Having live young
    b. Having spores
    c. Rooting themselves
    d. Breaking off chunks of themselves

11. Corals are related to anemones and…
    a. Sea jellies
    b. Fish
    c. Hermit crabs
    d. Plants

12. When clownfish lay eggs…
    a. They drift in the ocean until they hatch
    b. The male takes care of them
    c. The mother carries them in her mouth
    d. They hatch right away

13. Clownfish are symbiotic with
    a. Hermit crabs
    b. Algae
    c. Anemones
    d. Shrimp

14. The lawnmower blenny is a herbivore that is camouflaged to look like…
    a. A poisonous fish
    b. A snail
    c. Kelp
    d. Algae

15. Reefs are important because?
    a. They are just a tiny part of the ocean
    b. They are beautiful
    c. They provide food and medicine
    d. All above are correct

16. Reefs are not threatened by…
    a. Salmon fishing
    b. Harvesting for aquariums
    c. Pollution
    d. Divers and snorkelers

17. To help protect reefs, we could educate…
    a. Fishermen
    b. Scuba divers
    c. People with aquariums
    d. All of the above

18. The marine aquarium council (MAC)…
    a. Wants aquariums in every home
    b. Protects reefs by collecting fish carefully
    c. Causes the most damage to reefs
    d. Sets up "artificial reefs"

19. Marine protected areas…
    a. Don't let anyone in
    b. Set up aquariums to protect fish
    c. Are bases guarded by Marines
    d. Have strict rules on fishing and diving to protect reefs

20. What is one thing that you can do to help save coral reefs?
    a. Recycle, reduce, reuse
    b. Only buy reef fish from a MAC certified store
    c. Do not collect sea shells or step on coral while snorkeling
    d. All of the above

APPENDIX

E

Appendix E

Pilot Test Question Modifications

- Several simple typos and spacing issues were identified and corrected.
- All questions and answers were reworded to be complete sentences for consistency.
- "All of the above" was added as letter "e" to all questions.
- Question 3 – was removed due to extra content that would not fit in the program time constraints.
- Question 4 – "d" was reworded from "Are a tiny part of the ocean with lots of animals" to "have many animals in a small area of the ocean".
- Question 6 – "a" was changed from "jewelry" to "Greenstone" and "c" was changed from "extinct" to "geodes".
- Question 9 – All answers were lengthened to be consistent with the correct answer.
- Question 14 – was removed because it was too specific and did not measure an educational objective of the program.
- Question 15 – the question was reworded for clarity.
- Question 19 – "b" was reworded for clarity
- Question 20 – "c" was split into, to "c" and "d".

APPENDIX

F

Appendix F

Official Pretest

Student Number______ Teacher______________ Hour______ Virtual____ On-site_____

Clownfish, Corals and Conservation
Potter Park Zoo

Pretest

Circle the best answer

1. Coral reefs have many different animals and plants in a small area. They are like the ________ of the ocean.
    a. deserts
    b. oceans
    c. rainforests
    d. mountains
    e. All of the above

2. Coral reefs need which type of water in order to grow?
    a. Warm, shallow, salty
    b. Cold, dark, deep
    c. Any kind
    d. Freshwater, lots of nutrients
    e. All of the above.

3. Coral reefs…
    a. are found in a very large portion of the ocean.
    b. are not important to the ocean.
    c. have very few animals and plants.
    d. have many animals in a small area of the ocean.
    e. All of the above.

4. In the United States, coral reefs are located in the ocean around Hawaii and…
    a. California.
    b. North Carolina.
    c. Florida.
    d. Maine.
    e. All of the above.

5. Coral reefs require sunlight because
    a. corals have symbiotic algae that need sunlight.
    b. they are afraid of the dark.
    c. the animals need sunlight to grow.
    d. it makes fish brightly colored.
    e. All of the above.

6. Corals used to grow in Michigan; today we find them in their natural form as...
    a. greenstone.
    b. plants.
    c. geodes.
    d. Petoskey stones.
    e. All of the above.

7. Corals have been living in oceans...
    a. only ten years.
    b. over 350 million years.
    c. since the ice age.
    d. since the Civil War.
    e. All of the above.

8. Coral is...
    a. an animal.
    b. a plant.
    c. a rock.
    d. a mineral.
    e. All of the above.

9. An individual coral organism is called a...
    a. polyp.
    b. coralline.
    c. bud.
    d. florial.
    e. All of the above.

10. When hundreds of identical coral individuals live together, it is called...
    a. symbiosis.
    b. a colony.
    c. a cluster.
    d. a family.
    e. All of the above.

11. Corals have ___________ that sway in the currents, and can sting predators.
   a. arms
   b. tentacles
   c. branches
   d. flags
   e. All of the above.

12. What provides corals with a kind of sunscreen?
   a. Protective oils.
   b. Fish providing shade.
   c. Mucus.
   d. Their symbiotic algae.
   e. All of the above.

13. Symbiosis is...
   a. when a cell splits into two separate organisms.
   b. when two organisms live together and help each other.
   c. a kind of plant that grows in a rainforest.
   d. making a clone out of a cell from the ocean.
   e. All of the above.

14. Corals can reproduce by...
   a. having live young.
   b. having spores.
   c. rooting themselves.
   d. breaking off chunks of themselves.
   e. All of the above.

15. Corals are related to anemones and...
   a. sea jellies.
   b. fish.
   c. hermit crabs.
   d. plants.
   e. All of the above.

16. When clownfish lay eggs...
   a. they drift in the ocean until they hatch.
   b. the male takes care of them.
   c. the mother carries them in her mouth.
   d. they hatch right away.
   e. All of the above.

17. Clownfish are symbiotic with
    a. hermit crabs.
    b. algae.
    c. anemones.
    d. shrimp.
    e. All of the above.

18. Hard corals...
    a. are rocks.
    b. build reefs with their skeletons.
    c. do not have tentacles.
    d. have bones that keep them strong.
    e. All of the above.

19. Corals protect themselves with...
    a. their teeth.
    b. ink they can squirt.
    c. their poisonous tissues.
    d. exoskeletons and stinging cells.
    e. All of the above.

20. Why are coral reefs important?
    a. They are just a tiny part of the ocean.
    b. They are beautiful.
    c. They provide food and medicine.
    d. They provide homes for many ocean species.
    e. All above are correct.

21. Reefs are not threatened by...
    a. salmon fishing.
    b. harvesting for aquariums.
    c. pollution.
    d. divers and snorkelers.
    e. All of the above.

22. To help protect reefs, we could educate...
    a. fishermen.
    b. scuba divers.
    c. people with aquariums.
    d. pet stores
    e. All of the above.

23. The Marine Aquarium Council (MAC)...
   a. wants aquariums in every home.
   b. protects reefs by collecting fish carefully.
   c. causes the most damage to reefs.
   d. build "artificial reefs".
   e. All of the above.

24. Marine protected areas...
   a. don't let anyone inside their boundaries.
   b. Build aquariums to protect fish.
   c. are bases guarded by Marines.
   d. have rules on fishing and diving to protect reefs.
   e. All of the above.

25. What is one thing that you can do to help save coral reefs?
   a. Recycle, reduce, reuse.
   b. Only buy reef fish from a M.A.C. certified store.
   c. Do not collect sea shells at the beach
   d. Do not step on coral while snorkeling.
   e. All of the above.

APPENDIX

G

Appendix G

Official Posttest

Student Number______ Teacher__________ Hour______ Virtual____ On-site_____

Clownfish, Corals
and Conservation
Potter Park Zoo

Posttest

Circle the best answer

1. Corals have been living in oceans…
    a. only ten years.
    b. over 350 million years.
    c. since the ice age.
    d. since the Civil War.
    e. All of the above.

2. Coral reefs…
    a. are found in a very large portion of the ocean.
    b. are not important to the ocean.
    c. have very few animals and plants.
    d. have many animals in a small area of the ocean.
    e. All of the above.

3. Coral reefs require sunlight because
    a. corals have symbiotic algae that need sunlight.
    b. they are afraid of the dark.
    c. the animals need sunlight to grow.
    d. it makes fish brightly colored.
    e. All of the above.

4. Marine protected areas…
    a. don't let anyone inside their boundaries.
    b. Build aquariums to protect fish.
    c. are bases guarded by Marines.
    d. have rules on fishing and diving to protect reefs.
    e. All of the above.

5. Coral reefs have many different animals and plants in a small area. They are like the ________ of the ocean.
    a. deserts
    b. oceans
    c. rainforests
    d. mountains
    e. All of the above

6. When hundreds of identical coral individuals live together, it is called...
    a. symbiosis.
    b. a colony.
    c. a cluster.
    d. a family.
    e. All of the above.

7. Corals protect themselves with...
    a. their teeth.
    b. ink they can squirt.
    c. their poisonous tissues.
    d. exoskeletons and stinging cells.
    e. All of the above.

8. Why are coral reefs important?
    a. They are just a tiny part of the ocean.
    b. They are beautiful.
    c. They provide food and medicine.
    d. They provide homes for many ocean species.
    e. All above are correct.

9. To help protect reefs, we could educate...
    a. fishermen.
    b. scuba divers.
    c. people with aquariums.
    d. pet stores
    e. All of the above.

10. Coral is...
    a. an animal.
    b. a plant.
    c. a rock.
    d. a mineral.
    e. All of the above.

11. What is one thing that you can do to help save coral reefs?
    a. Recycle, reduce, reuse.
    b. Only buy reef fish from a M.A.C. certified store.
    c. Do not collect sea shells at the beach
    d. Do not step on coral while snorkeling.
    e. All of the above.

12. Clownfish are symbiotic with
    a. hermit crabs.
    b. algae.
    c. anemones.
    d. shrimp.
    e. All of the above.

13. What provides corals with a kind of sunscreen?
    a. Protective oils.
    b. Fish providing shade.
    c. Mucus.
    d. Their symbiotic algae.
    e. All of the above.

14. Symbiosis is…
    a. when a cell splits into two separate organisms.
    b. when two organisms live together and help each other.
    c. a kind of plant that grows in a rainforest.
    d. making a clone out of a cell from the ocean.
    e. All of the above.

15. Corals used to grow in Michigan; today we find them in their natural form as…
    a. greenstone.
    b. plants.
    c. geodes.
    d. Petoskey stones.
    e. All of the above.

16. Coral reefs need which type of water in order to grow?
    a. Warm, shallow, salty
    b. Cold, dark, deep
    c. Any kind
    d. Freshwater, lots of nutrients
    e. All of the above.

17. Corals can reproduce by…
    a. having live young.
    b. having spores.
    c. rooting themselves.
    d. breaking off chunks of themselves.
    e. All of the above.

18. Reefs are not threatened by…
    a. salmon fishing.
    b. harvesting for aquariums.
    c. pollution.
    d. divers and snorkelers.
    e. All of the above.

19. In the United States, coral reefs are located in the ocean around Hawaii and…
    a. California.
    b. North Carolina.
    c. Florida.
    d. Maine.
    e. All of the above.

20. An individual coral organism is called a…
    a. polyp.
    b. coralline.
    c. bud.
    d. florial.
    e. All of the above.

21. Corals have ___________ that sway in the currents, and can sting predators.
    a. arms
    b. tentacles
    c. branches
    d. flags
    e. All of the above.

22. Corals are related to anemones and…
    a. sea jellies.
    b. fish.
    c. hermit crabs.
    d. plants.
    e. All of the above.

23. The Marine Aquarium Council (MAC)...

a. wants aquariums in every home.
b. protects reefs by collecting fish carefully.
c. causes the most damage to reefs.
d. build "artificial reefs".
e. All of the above.

24. When clownfish lay eggs...

f. they drift in the ocean until they hatch.
g. the male takes care of them.
h. the mother carries them in her mouth.
i. they hatch right away.
j. All of the above.

25. Hard corals...

k. are rocks.
l. build reefs with their skeletons.
m. do not have tentacles.
n. have bones that keep them strong.
o. All of the above.

APPENDIX

H

Appendix H

Teacher Questionnaire

Clownfish, Corals and Conservation Program

Teacher Questionnaire

1. **My class participated in a…**
 - ☐ Distance learning "virtual" program
 - ☐ On-site traditional program

Teacher Background

2. Full name ______________________________________ Date__________
3. Male___ Female___
4. Years of teaching experience __________

Contact Information

5. School Name____________________________________
6. School Address____
 ____
7. Contact email or phone number______________________

8. Do you describe yourself as…?

____African-American
____Asian-American
____White
____Latino/Hispanic American
____Native American
____Other________________

9. Indicate the ethnic backgrounds, by percent for your class, for the students in your class.

____African-American
____Asian American
____White
____Latino/Hispanic American
____Native American
____Other________________

10. What is the academic placement level of most of your students by percent? *(May be over 100%)*

____Honor students
____Achieving academically at and/or above average
____Achieving academically below average
____Labeled as "at-risk" academically
____Limited English Proficiency (LEP)
____Special Education Students

11. Did you use activities or lessons about coral reefs/oceans prior to the program?

____Yes ____No
If yes, please describe____
____
____
____

12. Were the program materials sent to you prior to the program helpful in preparing your class?

____Yes ____No

13. In what ways was correspondence with the zoo staff helpful...

a. ☐ What to expect of the program
b. ☐ Logistics of carrying out program
c. ☐ Instructions for students
d. ☐ Instructions for parents/guardians and permission slips
e. ☐ Other____
f. ☐ Not Applicable

14. Was the pretest/posttest easy to use? ____Yes ____No

15. The test length was...

____Too long
____About right
____Too short

16. Were the test questions appropriate for the education level of your students?

____Yes
____No, they were above the students' heads
____No, they were too easy

17. Did the pretest focus your students' attention while participating in the program?

____No
____Yes (If yes, how so?)____
____

18. Was the coral reef program a valuable learning experience for your students?
____Yes ____No

19. Did the program provide real-world examples that tied into your curriculum?
____Yes ____No

Please rate elements of the program:

1 – Strongly disagree
2 – Somewhat disagree
3 – No opinion
4 – Somewhat agree
5 – Strongly agree
6 – Not Applicable

20. Most of the students really enjoyed the program	1	2	3	4	5
21. The program was a unique learning experience	1	2	3	4	5
22. The interactive components helped my students to be involved	1	2	3	4	5
23. Real world examples were clearly presented	1	2	3	4	5
25. Students felt involved in something important outside the classroom	1	2	3	4	5
26. The students felt the programs had a high educational value	1	2	3	4	5
27. The program motivated students to seek out more information	1	2	3	4	5
28. My students enjoyed the content of the program	1	2	3	4	5
29. The program was effective for less motivated students	1	2	3	4	5
30. My students learned about the coral reef environment	1	2	3	4	5
31. My students learned about all the organisms that live in a coral reef	1	2	3	4	5
32. I would like to participate in more zoo programs in the future	1	2	3	4	5
33. Sometimes it was hard to hear the speaker	1	2	3	4	5
34. The material was too hard for students to understand	1	2	3	4	5
35. There needs to be more interaction during the program	1	2	3	4	5
36. There needs to be more hands-on activities	1	2	3	4	5
37. Students felt there was too much information covered	1	2	3	4	5
38. Students felt that the program was entertaining but had little educational value	1	2	3	4	5
39. Only my very smart students gained significantly from the program	1	2	3	4	5
40. I am not convinced that my students will want to learn more about this topic	1	2	3	4	5
41. The program was not new or innovative	1	2	3	4	5
42. I am afraid that my slower students did not follow the program					

1 2 3 4 5

43. I would not like to participate in other future programs of this type

1 2 3 4 5

If your class participated in the distance learning "virtual" program, **please continue** on to the next page.
If your class participated in the on-site program, please write any comments or concerns in the box below.

VIRTUAL PROGRAM PORTION

Experience with technology

44. I have access to a computer: *Check all that apply*

____At home
____In my classroom
____In the school library
____In the school computer lab/media center
____Other (please specify)______________
____I do not have access to a computer

45. Do you have Internet access? ____Yes ____No

46. Do you presently use the Internet in your classroom?
If yes, how often? ____

47. How often do you engage your students in computer activities for your classes?

____Several times a week
____Once per week minimum
____Once a month
____Once every few months
____Never

48. Do you have any experience with video-conferencing-based distance education besides the "Clownfish, Corals and Conservation" program?

____Yes ______No *(If no please skip to question 50.)*

49. Does your class have any prior experience with video-conferencing?

____Yes ____No

*If yes, please explain*______________________________________

50. Does your Information Technology Person (ITP) provide you with enough support to conduct video-based distance learning sessions with ease?

____Yes ____No

Please describe why or why not, and how we could help.

51. Do you believe the distance-learning program was as educationally effective as a on-site program would have been?

____Yes ____No

If no please explain why______________________________________

52. Did your students seem to enjoy the distance-learning format as opposed to a on-site

program? ____Yes ____No

53. How did the distance-learning program affect you/your students...*(You can select more than one)*

____It made my job harder (Why? ______________________________)

____It confused students, and detracted from their learning

____It worked well, but a traditional on-site program would have been better

____I prefer this format to a traditional field trip

____Other______________________________________

54. Was the distance-learning program less expensive than a traditional field trip to the exhibit? ____Yes ____No

55. What was the biggest drawback to the distance-learning program virtual field trip?

____

____

56. What was the best part of the distance learning program/experience?

____

____

____

57. Please share suggestions or other comments that you have about the program.

____

____

____

____

APPENDIX

I

Appendix I

Consent and Assent Forms

Clownfish, Corals and Conservation
Potter Park Zoo

Re: Research study – "Comparative Evaluation of Distance Learning "Virtual" programs and Traditional On-site Programs in Zoos and Aquaria". 12/27/05

Dear Teacher,

Your students have an opportunity to participate in the newly designed, "Clownfish, Corals and Conservation" education program with the Potter Park Zoo. In our effort to make the program as good as possible, we are conducting a program evaluation as a research study. Your class will be instrumental for helping us understand what portions of the program are working, and what portions are not. This will help us to fine tune the program in the future.

Tracy McMullen, a graduate student at Michigan State University, will be conducting a pre- and posttest to measure the knowledge that your students gain from the program as her graduate research. The results will be used for her graduate thesis, comparing the effectiveness of on-site programs with that of "virtual" programs. The tests will be given just prior to and just after the program, and will take about 5 minutes each. You may use test scores as a grade if you so choose, but test originals must be submitted to the evaluator.

The identity of your students will be kept strictly confidential, (after test administration, it will not even be known by the evaluator), and individual scores will never be discussed. Participation is completely voluntary. The tests can be discussed in class, and used as a learning tool for the students. The tests will help to focus your students during the program, helping them to be more interested, attentive and to have fun. With your permission, research could be conducted in your classroom, and your students will provide valuable data for making the "Clownfish, Corals and Conservation" program the best it can be. Student and teacher consent forms should all be collected by you, and returned to Tracy McMullen at the Potter Park Zoo.

Thank you,

Tracy McMullen
Zoo and Aquarium Management, ProMSc candidate
Michigan State University
Potter Park Zoo Education Intern

For questions regarding the research project, please contact Tracy McMullen at mcmull22@msu.edu or (517) 256-7173 1208 W Rundle Lansing, MI 48910
Or the project supervisor, Dr. Richard Snider, 517-355-8473 snider@msu.edu
235 Nat. Sci. East Lansing, MI 48824
If you have any questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact - anonymously, if you wish - Peter Vasilenko, Ph.D., Director of Human Research Protections, (517)355-2180, fax (517)432-4503, e-mail irb@msu.edu, mail 202 Olds Hall, Michigan State University, East Lansing, MI 48824-1047

Please return all consent forms to Tracy McMullen at the Potter Park Zoo
Please fill out a separate form for each class participating

••

I give permission a research study to be conducted in my class regarding the "Clownfish, Corals and Conservation" educational program at Potter Park Zoo.

Teacher Signature_______________________________Date___________

Teacher Name (PRINT)___________________________

School________________________Grade_______ Class_______________

Clownfish, Corals and Conservation
Potter Park Zoo

Re: Research study – "Comparative Evaluation of Distance Learning "Virtual" programs and Traditional On-site Programs in Zoos and Aquaria". 12/27/05

Dear Teacher,

As part of the research study, you will be asked to fill out a short questionnaire regarding your experiences with the "Clownfish, Corals and Conservation" educational program. This is completely voluntary, but would help to make a connection between the students' test score outcomes and the teachers' perceived outcomes. You may choose to participate, or discontinue at any point without consequence. There are no foreseeable risks involved with this study. Your confidentiality will be protected to the maximum extent allowable by law.

Please fill out the portion below if consent to completing this survey for the research study.

Thank you,

Tracy McMullen
Zoo and Aquarium Management, ProMSc candidate
Michigan State University
Potter Park Zoo Education Intern

For questions regarding the research project, please contact Tracy McMullen at mcmull22@msu.edu or (517) 256-7173 1208 W Rundle Lansing, MI 48910
Or the project supervisor, Dr. Richard Snider, 517-355-8473 snider@msu.edu
235 Nat. Sci. East Lansing, MI 48824
If you have any questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact - anonymously, if you wish - Peter Vasilenko, Ph.D., Director of Human Research Protections, (517)355-2180, fax (517)432-4503, e-mail irb@msu.edu, mail 202 Olds Hall, Michigan State University, East Lansing, MI 48824-1047

Please return all consent forms to Tracy McMullen at the Potter Park Zoo

....

I consent to completing a teacher questionnaire regarding the "Clownfish, Corals and Conservation" educational program at Potter Park Zoo.

Teacher Signature________________________________Date____________

Teacher Name (PRINT)____________________________

School________________________ Grade_______ Class________________

Clownfish, Corals
and Conservation
Potter Park Zoo

Re: Research study – "Comparative Evaluation of Distance Learning "Virtual" programs and Traditional On-site Programs in Zoos and Aquaria". 1/24/05

Dear student,

You have a chance to participate in the new, "Clownfish, Corals and Conservation" lesson with the Potter Park Zoo. In trying to make the lesson as good as possible, we are doing a research study to see how well we can teach the material. You have an opportunity to help us understand how we are doing.

Before the program you will take a 5-minute pretest. You will then have the coral reef program, and following it, you will take a 5-minute posttest. You are not being graded. We are using these tests to measure how much you have learned from our program. This will help us do a better job next time.

You do not have to participate is you do not want to. You can refuse to answer questions if you choose. The tests will help to focus your attention during the program, helping you to be more interested, to ask great questions, and to have fun. With your help, you will provide valuable data for making the "Clownfish, Corals and Conservation" program the best it can be. If you have questions, please speak with your parents, or ask your teacher to contact the researcher with your questions.

Thank you,

Tracy McMullen
Potter Park Zoo Education Intern

Clownfish, Corals
and Conservation
Potter Park Zoo

Re: Research study – "Comparative Evaluation of Distance Learning "Virtual" programs and Traditional On-site Programs in Zoos and Aquaria". 12/27/05

Dear Parent,

Your child has an opportunity to participate in the newly designed, "Clownfish, Corals and Conservation" education program with the Potter Park Zoo. In our effort to make the program as good as possible, we are conducting a program evaluation as part of a research study. Your child has an opportunity to help us understand what portions of the program are working, and what portions are not, so we can fine tune the program for future students.

Tracy McMullen, a graduate student at Michigan State University will be conducting a pre- and posttest to measure the knowledge that your child gains from the program as her research project. The results will be used for her graduate thesis, comparing the effectiveness of on-site programs with that of "virtual" programs. The tests will be given just prior to and just after the program, and will take about 5-10 minutes each.

The identity of your child will be kept strictly confidential, (after test administration, it will not even be known by the evaluator), and individual scores will never be discussed. Your child's confidentiality will be protected to the maximum extent allowable by law. Participation is completely voluntary. Your child may choose to participate, or not, at any point without any consequences. There are no known risks associated with participation in this study. The tests can be discussed in class, and used as a learning tool for the students. The tests will help to focus your child's attention during the program, helping them to be more interested, to ask great questions, and to have fun. With your permission, your child will provide valuable data for making the "Clownfish, Corals and Conservation" program the best it can be.

Thank you,

Tracy McMullen
Zoo and Aquarium Management, ProMSc candidate
Michigan State University
Potter Park Zoo Education Intern

For questions regarding the research project, please contact Tracy McMullen at mcmull22@msu.edu or
(517) 256-7173 1208 W Rundle Lansing, MI 48910
Or the project supervisor, Dr. Richard Snider, 517-355-8473 snider@msu.edu
235 Nat. Sci. East Lansing, MI 48824

If you have any questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact - anonymously, if you wish - Peter Vasilenko, Ph.D., Director of Human Research Protections, (517)355-2180, fax (517)432-4503, e-mail irb@msu.edu, mail 202 Olds Hall, Michigan State University, East Lansing, MI 48824-1047

Please return the bottom portion to your child's teacher
(The teacher will submit all forms to Tracy McMullen at the Potter Park Zoo)

I give permission for my child to participate in the pre- and posttest of the "Clownfish, Corals and Conservation" educational program at Potter Park Zoo.

Parent Signature______________________________ Date____________

Parent Name (PRINT)_______________________________

If your child wishes to participate please have them fill out the section below.
Student Name_____________________________________
Teacher______________ School______________________ Class___________

IRB APPROVAL LETTER

IRB Approval Letters

MICHIGAN STATE
UNIVERSITY

Initial IRB Application Approval

February 13, 2006

To: Richard SNIDER
219 Natural Science

Re: **IRB # 05-982** Category: EXPEDITED 1-2, 2-7
Approval Date: **February 10, 2006**
Expiration Date: **February 9, 2007**

Title: COMPARATIVE EVALUATION OF DISTANCE LEARNING "VIRTUAL" PROGRAMS VERSUS TRADITIONAL ON-SITE PROGRAMS IN ZOOS AND AQUARIA

The Institutional Review Board has completed their review of your project. I am pleased to advise you that your project has been approved.

This approval only allows research to be conducted with 7th grade students at Perry Middle School. If you would like to conduct research with any other school, please submit a revision form indicating the school(s) and a letter of permission from the Principal/Superintendent to receive approval by the IRB.

The committee has found that your research project is appropriate in design, protects the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an ***Application for Renewal*** application at least one month before expiration. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an ***Application for Revision*** to have your changes reviewed. If changes are made at the time of renewal, please include an ***Application for Revision*** with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Peter Vasilenko, Ph.D.
SIRB Chair

c: Tracy McMullen
1208 W Rundle Ave
Lansing, MI 48910

OFFICE OF REGULATORY AFFAIRS

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202 Olds Hall
East Lansing, Michigan
48824-1046
517-355-2180
Fax: 517-432-4503

www.humanresearch.msu.edu
SIRB & BIRB: IRB@msu.edu
CRIRB: crirb@msu.edu

MICHIGAN STATE UNIVERSITY

Revision Application Approval

April 21, 2006

To: Richard SNIDER
219 Natural Science

Re: **IRB # 05-982** Category: EXPEDITED 1-2, 2-7
Revision Approval Date: April 21, 2006
Project Expiration Date: February 9, 2007

Title: COMPARATIVE EVALUATION OF DISTANCE LEARNING"VIRTUAL" PROGRAMS VERSUS TRADITIONAL ON-SITE PROGRAMS IN ZOOS AND AQUARIA

The Institutional Review Board has completed their review of your project. I am pleased to advise you th**athe revision has been approved**

Revision to include changes to the duration dates of the project, additional research site (St. Johns) and also use of existing data from Laingsburg Middle School. This letter acknowledges that Jodie Fisher and Jolene Wells of St. Johns Middle School has been approved to conduct the research activities described for this specific project. Please notify the SIRB office of any other teachers who will be "engaged" in the research activities.

The review by the committee has found that your revision is consistent with the continued protection of the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an ***Application for Renewal*** application at least one month before expiration. If the project is completed, please submit an ***Application for Permanent Closure***

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an ***Application for Revision*** to have your changes reviewed. If changes are made at the time of renewal, please include an ***Application for Revision*** with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Peter Vasilenko, Ph.D.
SIRB Chair

c: Tracy McMullen

OFFICE OF REGULATORY AFFAIRS
Human Research Protection Programs

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