The Design and Implementation of Metrics to Assess a Marine Science Environmental Education Program

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THE DESIGN AND IMPLEMENTATION OF METRICS TO ASSESS A MARINE SCIENCE ENVIRONMENTAL EDUCATION PROGRAM

By
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A THESIS

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THE DESIGN AND IMPLEMENTATION OF METRICS TO ASSESS A MARINE SCIENCE ENVIRONMENTAL EDUCATION PROGRAM

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Environmental education, particularly marine science education, is an emerging discipline. Evaluations of existing programs are necessary and best practices must continue to be developed. Students from Miami Science Museum’s Upward Bound Math and Science program participated in a new series of environmentally focused activities called the Eco-Ambassadors program. This program consisted of seven activities, including kayaking, habitat restoration, and a film workshop. An assessment of the Eco-Ambassadors program, consisting of a pre-survey and a post-survey, was conducted for this study in order to determine the success of the program. The surveys assessed student’s experiences, interests, knowledge, and attitudes. No statistically significant difference was found between the pre-surveys and the post-surveys; however, responses tend to indicate a positive experience for the students and potential positive gains in interests and knowledge. It is recommended that the program continue and that evaluations continue in order to get a more complete, long term overview of the program.
Acknowledgements

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CHAPTER I: Introduction

1.1 Literature Review

1.1.1 Environmental Education

Environmental Education (EE) is a field that has grown in popularity over the past several decades. Two preeminent organizations, the North American Association for Environmental Education (NAAEE) and the National Environmental Education Advancement Project (NEEAP) define EE in similar ways, with NEEAP using UNESCO’s 1978 Tbilisi Declaration as reference, which states that “Environmental Education is a learning process that increases people’s knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action” (National Environmental Education Advancement Project 2013). This definition makes it clear that EE is not simply about informing people. Rather, it is about informing people in a manner that illuminates the issues and empowers people to work towards solving them.

Also evident in the definition from Tbilisi are the five categories of objectives that have become a focal point for many EE evaluations—awareness, knowledge, affect, skills, and participation. All of these objectives are important in assessing the environmental literacy and action of people. In 2006, McBeth and Volk sought to use the Tbilisi objectives to create a baseline environmental literacy study in the United States (2006). They did so by measuring “environmental sensitivity, ecological knowledge, environmental emotion (attitudes), issue and action skills, verbal commitment (willingness to act), and actual commitment (behavior)” in sixth and eighth grade
students across the country (McBeth and Volk 2006). As Heimlich points out, there is a lack of consensus in regards to the effect of attitudes on actual environmental behavior (Heimlich 2010). This highlights the importance of including measures of actual behavior in EE evaluations. The results of this study suggest that out of all the measurements, student’s ecological knowledge is highest and their issue and action skills are lowest. Additionally, verbal commitment tends to be higher than actual commitment (McBeth and Volk 2006). These results may point to a need for EE initiatives to place an emphasis on how students can utilize their ecological knowledge to identify environmental issues and understand how to mitigate them.

1.1.2 Marine Science Education

Marine Science Education is another field that has gained momentum recently; however, as it is much more specific than general EE, there is less emphasis and much less research on the subject. Back in the 1980’s when it was starting to emerge, marine education was described as “all formal and informal education experiences that impart information about the relationship of the global sea to all world systems and the impact of society upon that sea” (Fortner & Wildman). This definition was an important starting point for the field, but failed to include anything about empowering people to identify problems and work towards solutions. Numerous professional organizations now exist that bring together people working towards the goal of educating people on the marine environment, including the National Marine Educators Association (NMEA). NMEA collaborated with several other organizations to define the concept of “Ocean Literacy” in 2006. The term is defined as “an understanding of the ocean’s influence on you-and your influence on the ocean” (National Geographic Society 2006). This definition is a simpler
version of the 1980’s definition by Fortner and Wildman (1980). However, it is expanded upon to explain that “an ocean-literate person: understand the Essential Principles and Fundamental Concepts about the functioning of the ocean; can communicate about the ocean in a meaningful way; and is able to make informed and responsible decisions regarding the ocean and its resources” (National Geographic Society 2006). An extensive information booklet was created that goes on to explain in much more detail what is expected of someone in order to be referred to as ocean literate. This ocean literacy program is likely one of the most extensive and important in marine science education today.

1.1.3 Evaluation Methods

Evaluation of both EE and Marine Science Education programs is important in determining prior success and future directions. It is a practice that can take many forms depending on situations. The methods used to evaluate one program may not be suitable for another and thus, each program must investigate the many different approaches in order to develop the best process under their unique circumstances. Today there are a large number of guidelines that have been published specifically to guide organizations through the process of evaluation, including many that are specific to EE or Marine Science Education programs.

One such guide, “Designing Evaluation for Education Projects”, is published by the National Oceanic and Atmospheric Association (NOAA). It details twelve steps in the evaluation process as well as defining many important terms that evaluators should be familiar with. One important distinction that this guide illuminates is the difference between formative and summative evaluation methods. Formative evaluation occurs
during a project, while summative evaluation occurs at the end of a project (Simmons 2007). Carleton-Hug and Hug make the argument that evaluators tend to focus on summative evaluations, but need to focus more on formative evaluations as well. They also emphasize the need for diversifying evaluation methods as a whole because different methods can illuminate varying aspects of a program. Additionally, they discuss numerous other challenges and gaps in EE evaluation and research. Challenges include a lack of clear objectives for programs, a large variety of contextual factors that must be taken into account, and pressure to determine success quickly (Carleton-Hug and Hug 2010).

One prominent evaluation method, the questionnaire or survey, is detailed in NOAA’s guide. Surveys are used for “the systematic and standardized collection of data” and involve self-reporting by participants in written or verbal form. The benefits of using surveys range from being time efficient, allowing for anonymous expression, and the collection of both qualitative and quantitative data. Several limitations are also pointed out, including a difficulty in creating questions that assess what they are intended to and a limited ability to deal with unanticipated responses. It is also pointed out that the survey method may be helpful in measuring knowledge, skills, attitude, and sometimes behavior (Simmons 2007).

In an attempt to obtain specific quantitative data, many surveys utilize Likert Scale statements and responses. These involve statements with response options on a scale such as “Strongly Disagree”, “Disagree”, “Neutral”, “Agree”, or “Strongly Agree”. They may also include a scale of numbers that corresponds to agreements statements.
1.1.4 Case Studies

Several case studies have been done on environmental education and even marine science education programs. These studies provide valuable insight into the structure and success of each. Ronald Needham did one such study in 1975 at the Samoan Sea Study Labs (SSSL) in American Samoa. This study was specifically intended to measure the changes in attitudes towards the sea of ninth grade students who completed a course at the SSSL. The course involved laboratory activities in the field and at the on-shore marine laboratory. The methodology involved thirty Likert scale statements based on an attitude definition of “A relatively enduring system of evaluative, affective reactions based upon and reflecting the evaluative concepts or beliefs which have been learned about the characteristics of a social object or class of social objects.” In the end, Needham did find that the SSSL course “caused an improvement of attitudes toward the sea” in the participants (Needham 1975).

A more recent study evaluated an EE program called Earth Force that strives “to engage young people as active citizens who improve the environment and their communities now and in the future” (Donoghue 2011) Earth Force provides EE programming to schools in Charleston, South Carolina to use in classroom settings and after school programs. The study investigated the effectiveness of Earth Force’s programs by using a post survey of participants from elementary, middle, and high school. The survey was unique in that it studied students over a wide range of grade levels and it included several questions that asked students to create a drawing. The study concludes that Earth Force is effective in creating potential environmental stewards, which is evident in their objectives (Donoghue 2011).
Many gaps exist in the literature in regards to EE and marine science education evaluations. One of these is in demographics. Previous studies have mostly been of white, middle-upper class students (Donoghue 2011). This is not surprising considering the demographics of our nation as well as the effect of socio-economic status on proximity to the natural environment and access to curricular and extracurricular environmental programs (Louv 2008). There are also many more EE evaluation studies than there are marine science education evaluation studies. This is likely due to the fact that the environment is a broader subject matter. Also, more general EE programs exist and many more people have direct access to the environment in general than the ocean and marine environment specifically.

One other noticeable gap based on my literature review is that of evaluations of long term or ongoing environmental programs. Then evaluations I have found tend to focus on one specific, short-lived environmental course or activity. These often involve a pre and a post survey that are given in the same day and, while still valuable, fail to take into account what happens after the passage of time.

1.2 Eco-Ambassadors

The Eco-Ambassadors program is a new initiative funded by a State Farm Youth Advisory Board (YAB) grant and run by the Reclamation Project in collaboration with Miami Science Museum’s Upward Bound Math and Science program (UBMS). The intent of State Farm YAB grants are to fund youth-led service learning projects. UBMS is a program comprised of high school students from low-income households where they will be the first in their family to attend college. The Eco-Ambassadors program aims to involve the UBMS students in habitat restoration, outdoor activities, the creation of
environmental Public Service Announcements, and other activities to enhance their knowledge of and appreciation for the environment. The three specific goals, as stated in the initial grant application, are “to increase the awareness of habitat restoration…give youth a voice in their immediate community to engage their peers in environmental awareness and responsibility…[and] enhance opportunities for students in underrepresented communities in STEM fields and higher education” (Bretos 2012).

Because this is the first time this program is being implemented, it is unknown what impacts it will make on the students involved. The hope is that these students will become more familiar with South Florida’s environment, gain an appreciation for its importance, and potentially carry their new knowledge and appreciation forward into higher education and careers.

Environmental education programs aimed at youth are imperative to the future health of our environment. It is important that youth are intentionally exposed to the natural world in order to come to appreciate it, especially in our current world where children are spending less and less time outdoors. Children who live in the inner city are even less likely to spend quality time outdoors and thus, should be a focus of our environmental education efforts. The Eco-Ambassadors program aims to address the issue of environmental education, particularly in regards to marine environmental education, for inner city high school students involved in the Miami Science Museum’s UBMS Program.
CHAPTER II: Objectives

While it is imperative that we implement such environmental education programs, it is equally vital that we assess these programs. We must determine the effectiveness in terms of knowledge and appreciation of the environment brought about by involvement in the program. I intended for my assessment measures to provide important insight about the Eco-Ambassadors program’s impact on the participating students. In order to assess the success of the program, I designed and implemented the metrics for evaluation, which can be used to further develop the program in future years. The grant application also included intent to measure the success of the program through the use of a pre and post test, so my work will be directly used in reports back to the State Farm YAB. It was necessary that the program be evaluated in order to determine its success and future direction.

The goals of this study are to:

1) Design and implement assessment measures that will gauge the success of the Eco-Ambassadors program for the Upward Bound students.
2) Analyze the assessment measures in a way that can be utilized by program managers.
3) Compare my results with other similar assessments in order to determine the best practices for such programs moving forward.
CHAPTER III: Study Methods

3.1 Description of Study Area

It is important to note that the students who are participating in the Eco-Ambassadors program are unique and do not represent students, high school students, or even minority high school students in Miami. All of the participants are high school students in Miami-Dade County. Several inner city high schools with high poverty rates are targeted when recruiting for the program, but students come from a large variety of high schools in the end. Nearly every student is a minority, mostly black, receives free lunch, and will be in the first generation of their family to attend college. Additionally, students must apply and be accepted to the program. Most students already have a strong interest in math and science before applying and are academically motivated.

The Reclamation Project “is a participatory eco-art project.” The central focus of the organization is on a mangrove restoration project where volunteers collect red mangrove (*Rhizophora mangle*) seedlings, display them in plastic cups with water, and then replant them (Cortada 2013). I interned for this organization and it is the one that applied for and received the State Farm YAB grant. Because of the central focus of the organization, the Eco-Ambassadors program also had a strong component related specifically to mangroves.

As mentioned earlier, the Reclamation Project’s Eco-Ambassadors Program was created and funded on the basis of three main components—outdoor/environmental experiences, an environmental film workshop, and the creation of a tabletop erosion exhibit for the Miami Science Museum. The first two components were completed between September 2012 and February 2013, while the third will be worked on
throughout the remainder of 2013. Over the course of seven months, the Eco-
Ambassadors participated in seven main activities, all of which are described in detail
below.

On September 22, 2012, the students were introduced to the Reclamation Project and
the Eco-Ambassadors program by Program Director, Fernando Bretos. He discussed the
different species of mangrove found in South Florida, the ecological importance of
mangroves, and how the Reclamation Project is working to restore mangrove habitats.
They then had their annual welcome back barbecue at Crandon Park on Key Biscayne. In
addition to the normal festivities, however, they also walked to the northern tip of the
island to collect red mangrove seedlings. The students were briefed on how to identify
the seedlings and that they should collect propagules that were green and had not yet
started to grow. In about an hour, they collected several hundred seedlings to be used by
the Reclamation Project in installations over the next several months.

On October 27, 2012, the Eco-Ambassadors continued their exploration of the
outdoors through a trip to Florida International University’s Biscayne Bay campus where
they were introduced to several graduate students in marine and environmental science.
The morning was spent learning about marine ecology as well as watching a Changing
Seas documentary about bull sharks and alligators in the Everglades. One of the
filmmakers was present to discuss the film and answer questions from the students. They
were then taken on a tour of the campus, with stops at the butterfly garden, mangrove
restoration site, and shade house. Finally, in the afternoon, the students went seining in
the bay. They caught several small fish including a juvenile barracuda and were able to
observe them before returning the organisms to the water.
On November 17, 2012, a small group of the students went to Oleta River State Park where they explored past restoration projects by the Reclamation Project, observed an area that they will help restore at a later date, and went on a kayak tour of the park. They were exposed to the history of the park and introduced to the invasive species problem plaguing it, including both plants and animals. During the kayak tour they were able to explore mature, healthy mangrove habitats within the park.

On November 28, 2012, another small group of Eco-Ambassadors assisted with the replacement of the mangrove wall at the Miami Science Museum. They took down 1,100 plastic cups filled with water and maturing red mangroves, saved the mangroves, and then added new seedlings from their September collection day.

The seedlings that the students took down from the wall were replanted on December 8, 2012 at R. Hardy Matheson Preserve by the larger group of eco-ambassadors and some additional community members. On that day, the volunteers planted the seedlings along the banks of Snapper Creek. The area used to be covered in invasive plant species, but was cleared in order to restore the native habitat. Students were reminded of the importance of native habitat restoration and were able to physically be a part of doing so.

From January 2-7, 2013, many of the Eco-Ambassadors took part in a One Water film workshop put on by the Big Blue and You Foundation and Miami New World Cinema. Students worked in five groups, each with the mentorship of a young filmmaker, to create, film, and edit a Public Service Announcement (PSA) related to the environment and water. Each group filmed at a different location throughout Miami, including Bill Baggs State Park, Oleta River State Park, and the Miami Science Museum. Each film was
30-60 seconds long and included a message about human impacts on the environment. They have since been posted to the Miami Science Museum’s YouTube channel.

Students who participated in the film workshop were able to show off their work to friends, family, and museum staff on February 9, 2013 in the Miami Science Museum’s auditorium. They were all awarded a certificate of completion and a DVD copy of all of the films. During the event, a behind the scenes film was shown, along with each of the five PSA’s. The intent is to share these PSA’s with as many people as possible, both to show off the skills and talents of the Eco-Ambassadors, as well as to inspire others to take care of the environment.

3.2 Study

The study that was undertaken can best be described as a case study due to the specific program being studied and the small sample size.

I began by learning about each individual program and speaking with the many individuals in charge of each. This included many discussions about the purpose of the Eco-Ambassadors program, how to carry it out, and how the team wanted it to be evaluated. I learned about the students in the program and I got to know many of them as I became involved with it.

I then conducted an extensive literature review over the topics of environmental education, marine science education, evaluation methods, and evaluations of environmental and marine science education programs.

3.3 Evaluation Methods

Next, I designed the evaluation methods. I drew from numerous pieces of literature and discussions with involved parties when deciding on the use of pre and post surveys.
Both surveys included open-ended questions, questions with specific answers to choose from, and questions with a Likert-type scale from “Strongly Disagree” to “Strongly Agree” on a scale of 1-10. The type of question and the possible responses that I anticipated dictated the variety of response options. For those questions where several specific responses could be anticipated, those responses were included and respondents were asked to circle one. On the other hand, questions with a large variety of potential responses were left open-ended so that respondents did not feel restricted in any way.

For both surveys, I utilized several of the objectives from the Tbilisi Conference in order to gain a wide array of information. The sections in each survey, although not specifically delineated for respondents to see, were demographics, past experiences, interests, knowledge, and attitudes. The design of the survey was also influenced heavily by the information that Upward Bound and Reclamation Project leaders wanted to learn from them.

The structure of the Upward Bound program as a whole includes Saturday programming where all participants spend the day at the Miami Science Museum. In the mornings, the whole group is together and this is where I was able to conduct the surveys. On both occasions, I reminded students who I was and what the Eco-Ambassadors program was. They were asked to fill out the surveys honestly and completely and that they would be completely anonymous. They were also asked to refrain from talking to each other about their responses and to raise their hand and ask me if they had any questions.

Surveys were then collected and coded for ease of analysis.
3.3.1 Pre-Survey

The pre survey was created first and consisted of sixteen questions plus a few basic demographic questions (Appendix A).

Experience questions and response possibilities included:

- Have you participated in the IMPACT program before? If so, for how many summers? Responses for this question were open ended, although a response of a number anywhere from 0-5 was expected from each respondent.
- How often do you spend time in nature? Respondents circled one of the following options: “Every day”, “4-6 days per week”, “2-3 days per week”, “Once a week”, or “Rarely”.

Additionally, the pre survey included two questions about participation in the two Eco-Ambassador activities that took place prior to the survey. Respondents were able to circle “YES”, “NO”, or “I don’t remember” in response to the following questions:

- Did you participate in the mangrove seedling collection and barbecue in September on Key Biscayne?
- Did you participate in the field trip to FIU Biscayne Bay campus in October?

Interest questions and response possibilities included several open-ended response questions:

- What do you find most interesting about nature?
- What is your favorite subject in school?
- What would you like to study in college?
- What career would you like to pursue?
Knowledge questions were open-ended and focused on mangroves:

- What are the three main types of mangroves that can be found in South Florida?
- Which species of mangrove does the Reclamation Project restore?
- Name three different ecological functions of mangroves.

Finally, attitudes were measured with three statements and response possibilities of a number from 1-10, with 1 labeled as “Strongly Disagree”, 5 labeled as “Neutral”, and 10 labeled as “Strongly Agree”:

- It is important for people to spend time in nature in order to appreciate it.
- Mangroves are an important part of the ecosystem and should be preserved.
- We should work to restore habitats, such as mangroves and other wetlands.

### 3.3.2 Post-Survey

The post survey was created in a similar manner and consisted of almost identical questions to those on the pre survey, with several additions and a couple of questions removed (Appendix B). In total, it contained nineteen questions plus basic demographic information. The use of very similar surveys provided consistency in the analysis.

Experience questions and response possibilities included:

- Have you participated in the IMPACT program before? If so, for how many summers? Responses for this question were open ended, although a response of a number anywhere from 0-5 was expected from each respondent.
- How often do you spend time in nature? Respondents circled one of the following options: “Every day”, “4-6 days per week”, “2-3 days per week”, “Once a week”, or “Rarely”.

The post survey included a section where students were asked, “For each of the following activities, please write “YES” if you participated, “NO” if you did not participate, and “I don’t remember” if you are not sure whether you participated or not.” This was followed by a list of the seven Eco-Ambassador activities and a blank space for the response. This section was followed by three related, open-ended questions:

- Which of the activities that you participated in was your favorite and why?
- Which of the activities that you participated in was your least favorite and why?
- What are TWO specific things that you have learned through participation in activities with the Reclamation Project?

Also different on the post survey were two dichotomous questions with “YES” and “NO” as the possible responses:

- Overall, have you enjoyed the activities you have participated in with the Reclamation Project?
- Given the opportunity, would you like to participate in activities with the Reclamation Project again?

Interest questions and response possibilities included several open-ended response questions:

- What do you find most interesting about nature?
- What is your favorite subject in school?
- What would you like to study in college?
- What career would you like to pursue?
Knowledge questions were open-ended and focused on mangroves:

- What are the three main types of mangroves that can be found in South Florida?
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Finally, attitudes were measured with three statements and response possibilities of a number from 1-10, with 1 labeled as “Strongly Disagree”, 5 labeled as “Neutral”, and 10 labeled as “Strongly Agree”:

- It is important for people to spend time in nature in order to appreciate it.
- Mangroves are an important part of the ecosystem and should be preserved.
- We should work to restore habitats, such as mangroves and other wetlands.

### 3.3.3 Film Workshop Survey

A third survey was conducted that measured the impact of one specific Eco-Ambassadors activity, the One Water Film Workshop (Appendix C). This survey was a joint venture between Daniell Washington, director of One Water Workshops and myself. It included eight Likert style questions and four open ended questions. The Likert style questions were preceded by the comment: “Rate your agreement on a scale of 1-10 with the following statements based on your experience at the recent film workshop. A rating of 1 means you strongly disagree and 10 means you strongly agree.” These eight statements included four about knowledge and career paths in marine conservation and filmmaking:

- I am more knowledgeable about the process of film making now than I was prior to attending the workshop.
• I am more knowledgeable about marine conservation now than I was prior to attending the workshop.
• I am more likely to pursue a college degree and/or career path in the field of filmmaking now than I was prior to the workshop.
• I am more likely to pursue a college degree and/or career path in the field of marine or environmental science now than I was prior to the workshop.

Two of the remaining statements referred to working in teams:
• I am interested in working in collaborative teams when working on a creative project.
• I am more likely to serve in a leadership role when working on a team project.

The remaining two statements asked students about the overall workshop:
• I enjoyed the time I spent at the workshop.
• Please rate how well your group leader served as a mentor throughout the workshop.

The open-ended questions asked students to reflect on the workshop:
• Please list the new skills that you have gained during the workshop.
• Please describe your favorite part of the workshop.
• Please list and describe at least one way in which the workshop could be improved upon.
• Would you participate in another workshop if given the opportunity? Please explain.
3.4 Data Analysis

3.4.1 Coding

The pre and post surveys were coded based on the following criteria:

- For sex, a response of “Male” was coded as 1 and “Female” as 2.
- Age was coded based on the exact response of a number between 13 and 19.
- Year in school was coded as 1 for Freshman, 2 for Sophomore, 3 for Junior, and 4 for Senior.
- Length of participation in the IMPACT program was coded as 5 for no previous participation and 1-4 for the corresponding number of years.
- Questions with a “YES” or “NO” response were coded as 1 for “YES” and 2 for “NO”.
- Questions with “YES”, “NO”, and “I don’t remember” were coded the same as above with “I don’t remember” being coded as 3.
- For the time spent in nature question, responses were coded 1, 2, 3, 4, 5 for “Every Day”, “4-6 days per week”, “2-3 days per week”, “Once a week”, and “Rarely”, respectively.
- All responses for the favorite subject in school question were categorized as Science or Not Science and coded 1 or 2, respectively. Responses that were coded as Science were: Science, Biology, Anatomy & Physiology.
- Responses for both what the respondent would like to study in college and what career s/he would like to pursue were categorized as Environmental, Other Science, and Other. They were then coded 1, 2, or 3, respectively. For college, Environmental responses included: Environmental Science, Zoology,
Marine Biology, Biology. Other Science included: Health, Medical Science.
For career, Environmental responses included: CEO of the EPA, Zoologist, Marine Biologist, Oceanographer, Veterinarian. Other Science included: Doctor, Anesthesiologist, Microbiologist.

- The two knowledge questions that asked for three responses were coded based on the number of correct responses. Three correct responses was coded 1, two correct responses was coded as 2, one correct response was coded as 3, and no correct responses were coded as 4.
- The knowledge question asking for one response was coded 1 if correct and 2 if incorrect. Multiple answers also yielded an incorrect coding.
- The three statements with scaled responses were inherently coded, as the responses were all a number between 1 and 10.
- On the post survey, I also coded the questions asking for favorite activity and least favorite activity by numbering each activity, 1-7, and using 8 for a response of “all” and 9 for a response of “none”.
- Where no response was given, or an irrelevant response (eg. “IDK”) was given, the response was not coded.
- Where multiple answers were provided where only one was expected, the first response was used to code.
- Several of the questions were not coded due to a large number of unique responses.

The film workshop survey was not coded.
3.4.2 Statistics

I conducted a paired t-test for each question that was asked on both the pre and the post survey. Measures of central tendency were calculated for responses to the three attitude statements. Frequency distributions were created for each coded question on both the pre and post survey. For most questions with three to five coded response options, a pie chart was created. The exception to this was the questions that asked students if they participated in each activity. Although only three answer choices were available for each, they were all combined into a bar graph instead of individual pie charts. For questions with more than six coded response options, a bar graph was created that shows both pre and post survey results together. A combined bar graph was created for favorite and least favorite activities.

The film workshop survey was not statistically analyzed.
CHAPTER IV: Results

Forty-three students were in attendance and responded to the pre survey. Forty-two students were in attendance and responded to the post survey. Fourteen students responded to the film workshop post survey. As mentioned earlier, not all respondents answered every question. In the analysis, any question left blank was not included. This is why the frequencies for each question do not always add up to the number of students who completed the survey overall.

The t-tests for each question that was identical on the pre and the post survey showed that there was no statistical difference between any of the surveys. The null hypothesis for each test was that there is no difference between the two means. There was a confidence interval of 95% and therefore the alpha was .05. The p-value for each test was greater than .05; therefore I am able to accept the null hypothesis for each one. Two representative examples of these t-tests for the questions “It is important for people to spend time in nature in order to appreciate it” and “Name three different ecological functions of mangroves” can be seen in tables 1 and 2, respectively.

<table>
<thead>
<tr>
<th>t-Test: Two-Sample Assuming Equal Variances</th>
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<td>Variance</td>
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<td>df</td>
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<tr>
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<tr>
<td>t Critical two-tail</td>
<td>2.1199053</td>
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Table 1. T-test for the question “It is important for people to spend time in nature in order to appreciate it.”
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Table 2. T-test for the question “Name three different ecological functions of mangroves.”

### 4.1 Demographics

Basic demographic information was very similar between the pre and post surveys. Forty-nine percent of both survey respondents were male and 51% were female in each case. Most respondents on both the pre and post surveys were between the ages of fourteen and seventeen (Figures 1 and 2), as would be expected with high school students. Grade distributions can be seen in Figures 3 and 4. Respondents attended a wide variety of high schools in Miami-Dade County and a couple are homeschooled.

### 4.2 Experiences

The number of summers each respondent has been in the UBMS program is also very similar between pre and post, with the exception that 10% more respondents had only been in the program for one summer on the post survey than the pre survey and 13% less had been in the program for two summers on the post survey than on the pre survey. Ninety percent of respondents on the pre survey and 87% on the post survey had been in the summer program for one, two, or three summers (Figures 5 and 6).
Figure 1. Age of students on the pre-survey

Figure 2. Age of students on the post-survey

Figure 3. Student's year in school on the pre-survey

Figure 4. Student's year in school on the post-survey
When asked about other outdoor experiences they have had on the pre-survey, respondents provided a wide array of answers. Several students have participated in beach cleanups, a few listed sports, and some responded that they have not had any.

The number of respondents who participated in each of the seven activities can be seen in Figure 7. The event with the most attendees was the film screening, while the events with the lowest number of attendees were the mangrove wall take down and the film workshop.

**4.3 Interests**

Figure 8 displays the respondent’s favorite and least favorite activities out of the ones that each participated in. The activity listed as favorite most often was the mangrove planting; however, it was also listed as least favorite more often than any other specific activity. The most popular overall response to least favorite activity was “none”.

![Figure 5. Number of summers in the UBMS program on the pre-survey](image)

![Figure 6. Number of summers in the UBMS program on the post-survey](image)
Figure 7. Number of students who participated in each event

- Mangrove Seedling Collection: Yes 27, No 13, I don't remember 2
- FIU Field Trip: Yes 26, No 13, I don't remember 3
- Oleta State River Park: Yes 24, No 17, I don't remember 1
- Mangrove Wall: Yes 25, No 16, I don't remember 1
- Mangrove Planting: Yes 27, No 13, I don't remember 2
- Film Workshop: Yes 25, No 16, I don't remember 1
- Film Screening: Yes 33, No 9, I don't remember 0

Figure 8. Student's favorite and least favorite activities

- Favorite: Mangrove Seedling Collection 6, FIU Field Trip 5, Kayaking trip 6, Taking down the mangrove wall 9, Mangrove planting 8, Film workshop 5, Film screening 4, All 3, None 0
- Least Favorite: Mangrove Seedling Collection 3, FIU Field Trip 1, Kayaking trip 1, Taking down the mangrove wall 2, Mangrove planting 3, Film workshop 0, Film screening 0, All 0, None 14
The responses as to why an activity was a favorite or least favorite varied. One interesting similarity is that respondents who chose the mangrove planting as their favorite activity and those who chose it as their least favorite activity often said that it was because they got muddy. Several respondents who liked the planting the most also said they did because they felt like they were helping the environment. Those who enjoyed the film workshop the most generally liked that they were able to learn new things and be creative.

Ninety-five percent of respondents said that they enjoyed the activities that they participated in and that they would like to participate in activities with the Reclamation Project again. When asked to list two specific things they learned by participating in the program, a large number of students mentioned learning about mangroves (how to plant them, why they are important, etc.), with several mentioning the need to help the environment in general.

On the pre survey, 83% of respondents said that they enjoy spending time in nature, while 17% said that they do not. On the post survey, 88% responded in the affirmative and 12% in the negative. Despite this, well over one third of the respondents on both the pre (38%) and post (42%) surveys indicated that they rarely spend time in nature (Figures 9 and 10).

On both the pre and post surveys, students provided a large variety of answers to what they find most interesting about nature. Some of the answers that showed up more than once were animals and the peacefulness.
On the pre survey, 27% of respondents indicated that their favorite subject in school was a science, while 73% indicated a non-science as their favorite subject. These numbers changed by 13% on the post survey, with 40% responding with a science as their favorite subject and 60% with a non-science.

As can be seen in figures 11 and 12, 26% of respondents on both the pre and post survey listed an environmental degree as what they would like to study in college. On the pre survey, 13% indicated that they would like to study another type of science, and 61% indicated a non-science. On the post survey, 24% indicated another type of science and 50% indicated a non-science.
Career aspirations were very similar on both the pre and post survey. Twenty percent of respondents on the pre and 16% on the post said that they would like to pursue and environmental career. Twenty percent on the pre and 21% on the post would like to pursue another science based career, while 60% on the pre and 63% on the post would like to pursue a non-science related career (Figures 13 and 14).

### 4.4 Knowledge

A large majority of respondents on the both the pre (84%) and post (78%) surveys were able to correctly identify that the three main types of mangroves found in South Florida are red, black, and white. Six percent on the pre survey and 19% on the post survey correctly identified two of the three. Ten percent on the pre survey and 3% on the post survey only correctly identified one of the three (Figures 15 and 16).
Figure 13. Student's career aspirations on the pre-survey

Figure 14. Student's career aspirations on the post-survey

Figure 15. The number of correct responses students gave to the question "What are the three main types of mangroves that can be found in South Florida?" on the pre-survey

Figure 16. The number of correct responses students gave to the question "What are the three main types of mangroves that can be found in South Florida?" on the post-survey
When asked which species of mangrove the Reclamation Project restores, 62% of respondents on the pre survey and 78% of respondents on the post survey correctly answered red.

Figures 17 and 18 show how many correct responses out of three the respondents gave when asked to name three different ecological functions of mangroves. Only 30% of respondents gave three correct functions on the pre survey, whereas on the post survey, 54% of respondents gave three correct functions.

4.5 Attitudes

Responses on a scale of 1-10 for the statement “It is important for people to spend time in nature in order to appreciate it” are compared for the pre and post surveys in figure 19. The most popular ranking for both was 10, and no respondent ranked below 3. The median on both the pre and post was 8.
For the statement “Mangroves are an important part of the ecosystem and should be preserved”, the responses are shown in figure 20. Again, the most popular response was 10. The median for both surveys was 9.

Figure 21 shows the responses to the statement “We should work to restore habitats, such as mangroves and other wetlands”. Ten was the most popular response and the median on both surveys.
Figure 20. Responses (on a scale of 1-10) to the statement "Mangroves are an important part of the ecosystem and should be preserved." A response of one indicates strong disagreement, a response of 5 indicates neutral, and a response of 10 indicates strong agreement.

Figure 21. Responses (on a scale of 1-10) to the statement "We should work to restore habitats, such as mangroves and other wetlands." A response of one indicates strong disagreement, a response of 5 indicates neutral, and a response of 10 indicates strong agreement.
CHAPTER V: Discussion

There is a lack of evidence in this study to conclude that any differences exist between the pre survey results and the post survey results; however, many of the results appear promising and several of the open-ended responses provide great insight into the program from the student’s perspective.

It is interesting that so many students enjoy spending time in nature, yet a large number of them rarely spend time in nature and a large number responded that they have not had any outdoor experiences outside of the Upward Bound program. The term nature was not defined for the students so that is based on their own interpretation, which may impact the answers. The fact that they rarely spend time in nature coincides with Louv’s discussion of a lack of nature for inner city children (2008). Because nearly all of these students reside in the inner city, it is understandable that many of them do not spend a significant time in nature. This underscores the necessity of programs like UBMS and the Eco-Ambassadors that provide opportunities for these students to spend quality time in nature.

It is encouraging that just over one quarter of the students want to study an environmentally related subject in college. This number did not change between the pre and post surveys, but it is probably higher than one would find amongst the general high school population.

One of the most important things to note with this study is that these students apply and are selected to be a part of the Upward Bound program. Therefore, they are more likely than the general high school population to be strong academically and to have a
strong interest in science. The results may have been dramatically different if this study had been done with a less selective group of students.

A large number of marine science education programs exist, including many others in Florida and several in Miami as well. Some of these programs have collected survey data that can serve as a point of comparison for the data in this study, including two program evaluations at the Marjory Stoneman Douglas Biscayne Nature Center (Bliss 2007; Lampe 2012). The Biscayne Nature Center (BNC) is an organization on Key Biscayne that provides educational coastal ecology programs, including many programs for school groups of all ages (Bliss 2007).

Bliss’ study, which was conducted in the fall of 2006, evaluated two specific courses that are available to school groups at BNC, Seagrass Adventure and Fossil Reef Adventure. Much like my study of the Eco-Ambassadors program, this study involved a pre and post survey for students. The major difference with this study is that it was conducted for very specific activities that occurred in one day instead of over an extended period of time. Also, a much larger group of students were surveyed due to the volume of students participating in the BNC programs. Despite these differences, the results of the study are relevant to the current study for several reasons. The study found that the educational programs met several of BNC’s goals about having fun, exploring the ecosystem, and gaining relevant knowledge about seagrass beds and fossil reefs. In similar fashion, the Eco-Ambassadors program may have helped increase the knowledge of the responding students about mangroves. It also found that students appeared to have enjoyed the activities. In both studies, the fact that students were able to interact directly
with the coastal environment was probably an important factor in increasing knowledge and providing an enjoyable experience.

Lampe conducted a more recent study at BNC (2012). She specifically evaluated an experimental shark biology and ecology program through the use of a pre and post test. Again, some differences exist between Lampe’s study and this one, including the fact that the pre and post tests were given in the same day in regards to a very specific program and the fact that a much larger number of students were evaluated. Also, it is important to note that, instead of a survey, Lampe utilized what she called a test. The pre and post test were fully knowledge based and did not measure attitudes or enjoyment of the program. Therefore, her study may be compared to the knowledge portion of my study on a limited basis. The pre and post tests contained ten questions and Lampe found that, on average, students doubled their scores from the pre to the post test (2012). The results are promising and demonstrate that the students gained a significant amount of knowledge during the program that they attended. My study also shows that the knowledge of the students likely increased over the duration of the program in two out of the three applicable questions, although not as dramatically.
CHAPTER VI: Conclusion

6.1 Summary

The Eco-Ambassadors program has, at the very least, been an enjoyable experience for the dozens of Upward Bound students involved. These students were given the opportunity to explore nature, create environmental PSAs to share with the world, and they will soon have the chance to assist in the design and creation of a museum exhibit about mangroves. Unlike many inner city kids, they have been and will continue to be deliberately exposed to nature, which has been shown to positively influence a child’s behavior, success in school, and mental well being (Louv 2008). Thus, even if no specific positive results could be shown from the program, it is likely that many of the students are still experiencing positive outcomes due to their exposure to nature.

It does appear, however, that the current study demonstrates specific positive results that students are obtaining from the program. These are most evident in an increase in knowledge and a desire to study science in college. Ideally, the Eco-Ambassadors program will continue for many years to come, with relevant improvements and adjustments being made along with way. It is more important than ever that students, particularly those who spend most of their time in the inner city, are intentionally exposed to the environment. They should learn the importance of it and learn why and how to conserve and reclaim it.

6.2 Limitations

There are certainly limitations to the value of my study. Most importantly, it is a case study and the results cannot be directly applied to other marine science environmental education programs. The number of students involved was small and from
a very specific program, with no control group. Along with that, the surveys were not
done in a way so that I could compare individual student’s pre and post surveys. Instead,
I looked at the whole group pre and post. Similarly, I was dependent upon the students
who attended the program on each Saturday that I administered the survey. Not all
Upward Bound students were in attendance on either day, and it is likely that I have
several pre surveys from students who I do not have post surveys from and vice-versa.

Additionally, one issue I encountered was not being able to administer the pre-
survey prior to any exposure to the Eco-Ambassadors program. Students had already had
the opportunity to participate in the mangrove seedling collection and field trip to FIU’s
Biscayne Bay campus before they filled out the pre survey. This most likely would result
in answers between the pre and post survey being more similar than expected.

A couple of other limitations exist within the surveys. Some students missed or
omitted certain questions, with one student missing the whole second page of the post
survey. Also, I did not define the terms “nature” or “environment” for the respondents.
There are several ways that the terms could be interpreted and I have no way of knowing
how the respondents interpreted them or if there were multiple interpretations amongst
them.

6.3 Recommendations

Based on the survey results and my subjective evaluation of the program from a
facilitator and evaluator’s standpoint, I would recommend that the Eco-Ambassadors
program continue in the future and be improved upon. The hope is that the program will
receive financial support from another State Farm YAB grant for the 2013-2014 school
year.
More evaluations should be conducted in order to provide a more in depth look at the program, particularly over time. Surveys seem to be a suitable method, but several changes should be implemented, including:

1) The pre survey should be administered prior to any exposure to the program, preferably on one of the first couple of Saturdays of the Upward Bound program in the fall.

2) Terms, including “nature” and “environment” should be defined for the students, both verbally and in writing on the survey.

3) All questions, including demographic questions, should have a considerable amount of space between them. This should make it less likely that students will accidentally miss a question because it blends with another.

4) The survey administrator should create a system whereby s/he may glance at each survey as they are turned in to make sure that all questions have been responded to.

5) It would be ideal to have a system so that respondents can be anonymously identified and pre and post surveys can be connected.

Other methods of evaluation may be employed in the future as well. This may include focus groups with some or all of the students, and formative evaluations conducted throughout the duration of the program in order to determine topics that the students grasp and ones that should be covered in more depth.

Additionally, it would be ideal to have the students complete a survey at the end of each separate event they attend. This would provide specific information about each
event, more immediate feedback, and a more complete overview of the entire program.
The students have access to a computer lab at the Miami Science Museum and it could be
useful to create online surveys for the students to complete. This would eliminate the use
of paper and could help in making sure students answer every question.

In addition to recommendations for future evaluations of the Eco-Ambassadors
program, I have several ideas for improving the program’s implementation as a whole,
some of which may only be feasible with additional funding. First of all, students should
be more aware of what activities they participate in are part of the Eco-Ambassadors
program. Since they already meet every Saturday, the Eco-Ambassadors and Upward
Bound staff must directly state when a Saturday is Eco-Ambassadors programming and
how it relates to the overall goals of the program. Also, since the film workshop was very
popular and well liked by the participants, it would be nice to expand it so that more
students could participate in the future. This would involve adding a second week of the
workshop because the program can only accommodate a certain number of students at
one time. It would also be nice to add some more connections to the mangrove seedlings
that the students collect in the fall and plant in the spring. Students could potentially
assist in the maintenance of the mangrove wall at the Miami Science Museum by helping
to water and remove dead seedlings.

Ultimately, as with any program, this first year was also a learning experience.
The Eco-Ambassadors program went over very well with the students and the evaluations
also went well; however, there is always room for improvement and I have no doubt that
the program will continue to improve and become even more impactful for everyone
involved.
References

Bliss, Catherine. “Program Evaluation of Two Experimental Marine Education Programs at the Biscayne Nature Center, Key Biscayne, Florida.” MA internship report, Rosenstiel School of Marine And Atmospheric Science, University of Miami, Florida. 2007.

Bretos, Fernando. State Farm Youth Advisory Board Grant Application. 5/4/2012.


Appendices

Appendix 1—Pre-Survey

The Reclamation Project Eco-Ambassadors Pre-Survey

Sex:  Female  Male
Age:  12  13  14  15  16  17  18  19
Year in school:  Freshman  Sophomore  Junior  Senior
School: ________________________________

1. Have you participated in the IMPACT program before? If so, for how many summers?

2. Did you participate in the mangrove seedling collection and barbecue in September on Key Biscayne?
   YES  NO  I don’t remember

3. Did you participate in the field trip to FIU Biscayne Bay campus in October?
   YES  NO  I don’t remember

4. What are some outdoor experiences you have had outside of Upward Bound (at school, with other programs, etc.)?

5. Do you generally enjoy spending time in nature?
   YES  NO

6. How often do you spend time in nature?
   Every day  4-6 days per week  2-3 days per week  Once a week  Rarely

7. What do you find most interesting about nature?

8. What is your favorite subject in school?
9. What would you like to study in college?

10. What career would you like to pursue?

11. What are the three main types of mangroves that can be found in South Florida?

12. Which species of mangrove does the Reclamation Project restore?

13. Name three different ecological functions of mangroves.

Please rate the following statements based on your agreement with them:

14. It is important for people to spend time in nature in order to appreciate it.
   Strongly Disagree  Neutral  Strongly Agree
   1  2  3  4  5  6  7  8  9  10

15. Mangroves are an important part of the ecosystem and should be preserved.
   Strongly Disagree  Neutral  Strongly Agree
   1  2  3  4  5  6  7  8  9  10

16. We should work to restore habitats, such as mangroves and other wetlands.
   Strongly Disagree  Neutral  Strongly Agree
   1  2  3  4  5  6  7  8  9  10
Appendix 2—Post-Survey

The Reclamation Project Eco-Ambassadors Post-Survey

Please fill out this survey HONESTLY and THOROUGHLY, including providing an answer for each question. If a question asks for an explanation, please provide one.

Sex: Female  Male  Age: 12 13 14 15 16 17 18 19
Year in school: Freshman  Sophomore  Junior  Senior
School: ______________________

1. Have you participated in the IMPACT program before? If so, for how many summers?

2. For each of the following activities, please write “YES” if you participated, "NO" if you did not participate, and "I don’t remember" if you are not sure whether you participated or not.

   Mangrove seedling collection & BBQ on Key Biscayne in September 2012_________________

   Field trip to FIU’s Biscayne Bay campus in October 2012__________________

   Kayaking trip to Oleta River State Park in November 2012________________________

   Taking down the mangrove wall in November 2012______________________________

   Mangrove planting at R. Hardy Preserve in December 2012______________________

   One Water Film Workshop in January 2013_____________________________________

   Attending the One Water film workshop screening in February 2013_______________

3. Which of the activities that you participated in was your favorite and why?

4. Which of the activities that you participated in was your least favorite and why?

5. Overall, have you enjoyed the activities you have participated in with the Reclamation Project?
   YES  NO

6. Given the opportunity, would you like to participate in activities with the Reclamation Project again?
   YES  NO

7. What are TWO specific things that you have learned through participation in activities with the Reclamation Project?
8. Do you generally enjoy spending time in nature?  
   YES   NO

9. How often do you spend time in nature?  
   Every day   4-6 days per week   2-3 days per week   Once a week   Rarely

10. What do you find most interesting about nature?

11. What is your favorite subject in school?

12. What would you like to study in college?

13. What career would you like to pursue?

14. What are the three main types of mangroves that can be found in South Florida?

15. Which species of mangrove does the Reclamation Project restore?

16. Name three different ecological functions of mangroves.

---

Please rate the following statements based on your agreement with them:

17. It is important for people to spend time in nature in order to appreciate it.  
   Strongly Disagree   1   2   3   4   5   6   7   8   9   10  
   Neutral           4   5   6   7   8   9   10

18. Mangroves are an important part of the ecosystem and should be preserved.  
   Strongly Disagree   1   2   3   4   5   6   7   8   9   10  
   Neutral           4   5   6   7   8   9   10

19. We should work to restore habitats, such as mangroves and other wetlands.  
   Strongly Disagree   1   2   3   4   5   6   7   8   9   10  
   Neutral           4   5   6   7   8   9   10
Appendix 3—Film Workshop Post-Survey

Eco-Ambassadors – One Water Workshop Post-Survey
January 2-7, 2013

Rate your agreement on a scale of 1-10 with the following statements based on your experience at the recent film workshop. A rating of 1 means you strongly disagree and 10 means you strongly agree.

1. I am more knowledgeable about the process of film making now than I was prior to attending the workshop.
   1 2 3 4 5 6 7 8 9 10

2. I am more knowledgeable about marine conservation now than I was prior to attending the workshop.
   1 2 3 4 5 6 7 8 9 10

3. I am more likely to pursue a college degree and/or career path in the field of filmmaking now than I was prior to the workshop.
   1 2 3 4 5 6 7 8 9 10

4. I am more likely to pursue a college degree and/or career path in the field of marine or environmental science now than I was prior to the workshop.
   1 2 3 4 5 6 7 8 9 10

5. I enjoyed the time I spent at the workshop.
   1 2 3 4 5 6 7 8 9 10

6. I am interested in working in collaborative teams when working on a creative project.
   1 2 3 4 5 6 7 8 9 10

7. I am more likely to serve in a leadership role when working on a team project.
   1 2 3 4 5 6 7 8 9 10

8. Please rate how well your group leader served as a mentor throughout the workshop.
   1 2 3 4 5 6 7 8 9 10
9. Please list the new skills that you have gained during the workshop.

10. Please describe your favorite part of the workshop.

11. Please list and describe at least one way in which the workshop could be improved upon.

12. Would you participate in another workshop if given the opportunity? Please explain.