

EFFECTS OF USING AN OUTDOOR ENVIRONMENTAL EDUCATION  
PROGRAM ON STUDENTS' UNDERSTANDING OF ENVIRONMENTAL  
SCIENCE

by

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Angela Marie Swank

July 2013

## DEDICATION

This is dedicated to all the students I have taught over the years; your excitement and willingness to try new things keep me inspired to do the work that I do. Also to my fellow Outdoor Educators whose passion about the environment and dedication to this field is admirable together we make a difference in the lives of our students. Most importantly, to my family and friends who have been a constant support on my journey in education. It means the world to me and I couldn't do anything without you.

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## ABSTRACT

This research focused on the effect of using an Outdoor Environmental Education (OEE) program on students' understanding of environmental science concepts. Sixty-four 5<sup>th</sup>-grade students participated in the OEE program. Various data collection instruments were used to determine the effects on the students' understanding of the science concepts, long-term memory, attitude and motivation to learning science in their classroom, as well as the attitude and motivation of the teacher. These instruments included pre and posttreatment assessments, surveys, interviews, observations and journals. The study found that students' participating in the OEE program increased their understanding of environmental science concepts and lead to increased interest into learning science in their classrooms. This research also yielded an increased awareness of the effect of the teacher's attitude and motivation in teaching in a short-term education environment.

## INTRODUCTION AND BACKGROUND

For nearly 10 years, I have worked in the field of Outdoor Environmental Education (OEE) at the East Bay Outdoor School in the OEE program. I have been lucky enough to teach science concepts to my students in the forest, at a pond, near the ocean, or sitting in a field of wild flowers. When I was young, nature and the environment became the love of my life. When I realized that I could teach others about science and protecting the environment while being outside, my life changed forever. The OEE program is a residential (overnight), experiential learning experience where the OEE curriculum meets California State Standards.

In my position, I meet and teach a new group of students each week. The students come to my outdoor school as a field trip as a part of their regular elementary or middle school curriculum. As education in classrooms continues to become more focused on state testing and as there are struggles with budget constraints for field trips, it becomes more and more challenging for classroom teachers to justify taking the time away from school for this alternative learning experience.

My intention with this project was to take a closer look at the impact that using an OEE program has on my students learning environmental science concepts. From my reflection, I recognized that when my students departed from their OEE experience at the end of the week, I did not know what impact I was able to have on them and their overall understanding of environmental science concepts. For this reason, I chose effectiveness of OEE as my capstone project topic. I feel that this topic is important to me because I believe that teaching in an experiential education environment is beneficial to my students in understanding environmental science concepts while having the opportunity to experience the outdoors. I also think that it is important to classroom teachers and

school administrators, as it shows the benefits of an OEE program for their students learning and understanding of environmental science concepts in addition to the personal growth that they experience in the residential OEE program.

I teach OEE to fourth, fifth, and sixth grade students at East Bay Outdoor School in Livermore, California. I teach gardening, sustainability, geology, freshwater biology, and forest ecology. My students' change from week to week, but all students attending the program is from the San Francisco Bay Area. For the purpose of this study, the students that participated in the study were all fifth-grade students. The students are from various socioeconomic backgrounds and ethnic cultures to represent the range of students that I teach each year. The environmental science topics that were used in the study were rock types/ rock cycle and plate tectonics.

The project focus question is: what are the effects of using East Bay Outdoor School OEE program on students' understanding of environmental science? My project subquestions were as follows: what are the effects of using East Bay Outdoor School OEE on students' long-term memory of concepts; what are the effects of using East Bay Outdoor School OEE on students' motivation and attitude while at the OEE program; what are the effects of using East Bay Outdoor School OEE on students' attitude and motivation to do classroom work after their outdoor experience; and what are the effects of the short-term learning environment of East Bay Outdoor School on my thoughts of being an educator and my motivation?

My Capstone Advisor for this project is Jewel Reuter, PhD. My MSU Project Reader is Joseph Bradshaw from the Department of Intercollege Programs for Science Education. The remainder of my support team includes Brian Olkowski, a fifth grade

science teacher at a local elementary school. Brian's students attend my OEE program every year. Jenna Megalizzi, who is a seventh and eighth grade science teacher at a local middle school, is also a former outdoor educator and colleague. Jaclynn Davis, who is a friend who studied English and is a skilled writer; she is also a former colleague in the OEE field.

### CONCEPTUAL FRAMEWORK

Prior research supports the importance of OEE in students' understanding of environmental science concepts. The theory behind why experiential education is important in students' knowledge, understanding, and attitude towards environmental science is presented. Finally, various methods others have used when implementing OEE are examined.

Howard Gardner proposed the theory of multiple intelligences as a model of intelligence with various specific (primarily sensory) modalities, rather than seeing it as dominated by a single general ability (1983). His theory included the following as the original seven abilities: spatial, linguistic, logical- mathematical, bodily- kinesthetic, musical, and interpersonal. Later, naturalistic was added (Gardner, 1983). Traditional education has often valued linguistic and logical mathematical, but can often be lacking in the other areas.

The idea of teaching numerous students with different learning styles can be a bit daunting to any educator. Combine that with the added pressures of the focus on state testing, it can be hard to reach every student with each lesson taught in the classroom. The OEE program lends itself to a more general ease at reaching multiple learning styles based on the nature of the setting that OEE is conducted. John Dewey proposed the theory of experience. Dewey said that educators must understand the nature of how

humans have the experiences they do, in order to design effective education (1916).

According to Dewey, good education should have both a societal purpose and purpose for the individual student. Educators should be responsible for providing students with experiences that are immediately valuable (Dewey, 1916).

In OEE, the focus on learning is connected to all learning types to allow the students to comprehend the educational material that is being presented. Bogner (1998) implemented a pretreatment survey of 700 fifth-grade students prior to attending an OEE program in the Bavarian National Forest studying ecology to gauge their understanding of science concepts and their attitudes towards the environment. There was a 1-day program and a 5-day program. A posttreatment survey conducted one month after the OEE program visit, Bogner found the fifth graders had increased science knowledge retention and an increased proenvironmental attitude. He states that the posttreatment result is significant as students in the classroom often retain the information for a short time, from test to test (Bogner, 1998). Both the pretreatment and posttreatment took place in the students' school classrooms by their classroom teacher as to not distract from wanting to learn and explore immediately in the National Park. In another study (Gordon, 2011) that was conducted at an OEE program utilizing pretreatment and posttreatment surveys in a study conducted with middle school students at two different OEE programs in California. Gordon (2011) found that two-thirds of the students reported a greater increase in confidence in learning amongst peer groups and in their classroom work.

I found several additional studies that have been done regarding knowledge, attitude, and behaviors about the environment and environmental science concepts. One

study, Martin (2003) used a schoolyard to teach OEE concepts; it focused on fourth and fifth grade students' knowledge, attitudes, behaviors, and comfort levels in the outdoors and it used treatment and control groups along with a pretest and posttest on the previously stated variables. He found that there was a substantial increase in knowledge and comfort levels compared to that of the control group. Both the fourth and fifth grade students who participated in the schoolyard OEE concepts were able to score between 5-10 points higher on the posttreatment assessment.

Bogner (2002) used a four-day extracurricular education unit to teach OEE concepts. This study was a cognitive outdoors focus that 151 middle and high school students participated in. These students were participating in a program in France; the students were a mix of boys and girls, with 54% participating were male. Using a pre and posttreatment survey Bogner found that students reported increased motivation in schoolwork. Specifically students conveyed that they would participate in afterschool workshops about science if they were offered. They also described a desire for more fieldwork in their ordinary science classes.

In another study, Carrier (2009) implemented hands-on schoolyard activities and traditional classroom activities to teach environmental science concepts with 109 fourth and fifth- grade students. He found that the posttest scores of a study conducted on environmental education lessons in a schoolyard had increased scores compared to those in the classroom setting.

Knapp (1996) wrote about general findings from a list of school reform innovations that I find particularly insightful. He found that many ideas emerged in relation to students' learning connected to outdoor education programs. Some important

topics related to attitude and motivation of students learning include: creating meaning from interactive experiences rather than through lectures, leading students through problem-based learning formats connect students through life outside the school become more motivated to learn, knowledge retention is increased when students' interests can be applied in physical contexts and if students have positive reactions and feelings associated with learning they are more likely to want to learn more about that topic in the future.

Although studies show that OEE is beneficial to students, students are not always given the opportunity for an outdoor learning experience. There are barriers preventing children from interacting with the environment that include lack of teacher and/or administrator investment, funding, and proximity to the natural world. According to Richard Louv (2005), environment-based education dramatically improves standardized test scores and grade point averages and develops skills in problem solving, critical thinking and decision-making. Giving young people access and opportunity can change the way they learn about environmental science and how they think about the environment and their role in it.

Focusing purely on my role as a teacher in the environment, I sometimes struggle to see where I have impacted my students. I present similar topics to new students on a weekly basis. I often wonder if I am creating a change in my students and helping them understand the natural world around them more acutely. When I step back and look at the overall picture of my impact, I can see that I have created a unique experience for my students that is much different than their traditional learning environment, leading them to new experiences. In Foran's (2005) research, he found outdoor educators being able to

identify the importance of their relationships with their students when teaching outdoors. Not only are these educators responsible for the students' education, but also they take on the responsibility for the students' care and safety in an unpredictable environment. He states, "for the teacher, [there is] a heightened awareness for safety, control, and environmental risk; learning lesson outside places greater focus on the pedagogic relationship" (Foran, 2005, p. 155).

In conclusion, classroom teachers are teaching to students with a variety of learning styles that can create a challenge to effectively teach environmental science concepts to all of their pupils with an individual lesson. The OEE program provides access to environmental science concepts through a variety of teaching methodologies including experiential education. Although it can be difficult for schools to take time away from the classroom for OEE trips, it is important that schools take the time for such learning experiences for their students. Finally, many of the procedures and strategies were applied to my personal capstone project to attempt to improve students' understanding of environmental science.

## METHODOLOGY

### Project Treatment

To determine the effectiveness of using OEE program on students understanding of environmental science, I compared data collection without this intervention (nontreatment unit) to data with this intervention (treatment units). The nontreatment unit took place in a science classroom at Coyote Creek Elementary School of a group of fifth-grade students that also attended the OEE program. The students that took part in the nontreatment were different students than those that took part in the treatment. The

classroom teacher taught the nontreatment unit while I observed the class. It was a lecture-based lesson about an environmental science concept taught in the school. The focus of this lesson was rocks and the rock cycle. I observed the teacher's teaching techniques in the classroom and took notes on the students in this environment. I focused on how the students responded to the material taught by their teacher as well as how they interacted with the teacher and their fellow classmates. I paid close attention to the students understanding of the concepts and tried to gain an understanding of their preferred learning styles. The treatment units took place at East Bay Outdoor School, which is an OEE teaching facility where I taught the lessons. I used a hands-on learning approach to teaching the environmental science concepts including exploration, experiential learning, inquiry, and using diverse activities, such as games and songs that incorporate various learning styles in an attempt for the material to reach all of the students in the group. The treatment units were focused on two different environmental science concepts. These concepts were rock types/ the rock cycle and plate tectonics. My teaching methods for these treatment units are experiential and inquiry based in an outdoor setting.

A sample lesson plan that was used by the classroom teacher while I observed the nontreatment unit about rock types and the rock cycle included the following description. The nontreatment lesson took place in a classroom introducing key vocabulary words and teaching the students note taking skills. The majority of the lesson was the classroom teacher reading with the students from the textbook, repetition of vocabulary words and definitions, and the teacher asking closed-ended questions. He vacillated between

lecturing of new terminology and questioning student about vocabulary words and definitions. A full description of the lesson can be found in Appendix A.

A sample lesson plan that I used while teaching a treatment unit about rock types and the rock cycle included the following description. The treatment lesson was focused on hands-on learning in an outdoor environment. While teaching I carry all of my supplies with me on the hike as well as a white board for writing key vocabulary words. The outdoors is the classroom during the treatment unit. At various points along the trail we stopped to study the environment and relate them to our environmental science objectives. We used an outcrop of limestone to explore the concept the rock cycle and learning about metamorphic, sedimentary, and igneous rocks. I used a song about the different types of rocks to teach my students about rocks and how they form. I did an activity with the use Skittles candy to discuss and demonstrate the change of a sedimentary rock to a metamorphic rock. We looked at real rock samples to see the visual differences between the rock types. Finally, we used a visual aid of the rock cycle to review and check for understanding of the rock cycle. A full description of the lesson plan can be found in Appendix B.

A sample lesson plan that I used with the treatment unit on plate tectonics included the following scenario. I took my students hiking and used the environment around us to act as our classroom, just as with the rock type lesson. We stopped along the trail to learn about our objectives. Using various local and state maps, we looked at how the landscape of California and the California Bay Area landscape were formed. We examined local faults, such as the San Andreas Fault and the Hayward Fault to understand the concept of plate tectonics. After presenting the vocabulary words

divergent fault, convergent boundaries, and transform fault we sang and danced to the tectonic waltz and played a game to reinforce the definitions of these terms. Finally, I used graham crackers and peanut butter on wax paper to review and check for understanding of how the earth's plates move. A complete lesson plan can be found in Appendix C.

I implemented many of the treatment surveys, assessments and interviews while the students were attending the OEE program. With the help of the students' classroom teachers, the preunit assessment took place in the school classroom. Also, the delayed treatment unit data collection required the help and support of the classroom teachers. I relied on them for help. I was able to visit the student classrooms for delayed treatment unit interviews and the teachers gave the students the delayed treatment unit assessments.

#### Data Collection Instruments

The project was conducted at East Bay Outdoor School in Livermore, California. There were four schools that participated in my project treatments. All of the students included in the project were fifth-grade students from the San Francisco Bay Area. In total, there were approximately 75 students participating in the project. Nearly half of the students in this study attended the OEE program with financial assistance of a local foundation as well as did fundraising in order to attend the program. The students' classroom teachers are advocates for the OEE experience for their students as it allows them to learn science concepts outside of the classroom environment. The students were nearly half boys and half girls. Since I teach a different set of students from one week to another, the range of students that I worked with was great. Not only were the students from different cities, their backgrounds varied in ethnicity, socio-economic status, and

attitudes toward learning. Below I describe the different school demographics of the students included in the project.

- The students from Coyote Creek Elementary live in San Ramon, CA. San Ramon is a fairly affluent community. The majority of the students are Asian and the school has a very low Free and Reduced Lunch Rate (FRL) of 14%. There were two weeks of Coyote Creek students participating; each week was a different group of students.
- The students from Lincoln Elementary live in Oakland, CA. Oakland is a very large city; the students from Lincoln Elementary live in a low socio-economic area. The students are a majority of Asian descent and many of them are English Language Learners (ELL). Their school's FRL is 92%. These students receive a large scholarship to attend the OEE program.
- The students from Rio Vista Elementary live in Bay Point, CA. Bay Point is a very poor community and the majority of the students are Hispanic. Many of the students are ELL students and their school has a FRL of 87%. These students receive a large scholarship to attend the OEE program.

I collected data for each of my project questions to allow for triangulation. Table 1 is the data triangulation matrix. Triangulation of the data with various instruments and various sources that I used such as student pre and postactivity assessments, student surveys, post and delayed unit student surveys and assessment, instructor field observation, student interviews, teacher reflection journal, pre and posttreatment attitude surveys, and observations by colleagues were important because they present various types of data to my Capstone project as well as various points of view to help me answer

my project questions. The students that were interviewed with were two high-achieving, two middle-achieving, and two low-achieving students per treatment unit.

Table 1  
*Triangulation Matrix of Data Sources by Project Question*

Project Questions	Data Source 1	Data Source 2	Data Source 3
<i>Primary Question:</i> What are the effects of using the East Bay Outdoor School Outdoor Environmental Education program on students understanding of environmental science?	Pre and postunit Student survey	Pre and postunit assessment	Pre and postunit interviews
<i>Secondary Questions:</i> What are the effects of using Outdoor Environmental Education of students' long-term memory of concepts?	Post and delayed treatment student survey	Post and delayed unit student interviews	Post and delayed unit assessment
What are the effects of using Outdoor Environmental Education on students' motivation and attitude?	Pre and posttreatment student survey	Instructor field observations	Pre and posttreatment student interviews
What are the effects of using Outdoor Environmental Education on students' attitude and motivation to do classroom work after their outdoor experience?	Pre and posttreatment student survey	Instructor field observations	Pre and posttreatment student interviews
What are the effects of a short-term learning environment on my thoughts of being an educator and my motivation?	Teacher reflection journal with prompts	Pre and posttreatment teacher attitude survey	Nontreatment and treatment observations by colleagues

To determine the effects of OEE on students understanding of environmental science topics, I used pre and postunit student surveys, pre and postunit assessments as well as pre and postunit interviews. The pre and postunit surveys, located in Appendix F and Appendix G, focus primarily on how the students prefer to learn and how learning is different at school versus the OEE program as well as earth science concepts. All of the students in each group took the preunit surveys prior to attending the OEE program and the postunit assessment after attending the OEE program at school. The pre and postunit assessment is located in Appendix D and Appendix E. This data collection instrument was used with all the students to check for prior knowledge of the science concepts, plate tectonics and rock cycles, as well as knowledge of the science concepts after the OEE program. The pre and postunit interviews, located in Appendix H and Appendix I, were given to six students in each group. The same high, medium, and low-level students were interviewed before and after the OEE treatment unit.

To understand the effects of using the OEE program on students' long-term memory of science concepts, I used post and delayed treatment student surveys, post and delayed unit interviews, and post and delayed unit assessments. The student surveys, interviews and assessments are described above and located in Appendices D-I.

The delayed unit student surveys, delayed unit interviews, and delayed unit assessments were conducted 14 days after attending the OEE program. These data collection tools are similar to the post treatment surveys, interviews and assessment; they are just conducted a delayed time from the treatment as stated. The delayed unit assessments are located in Appendices D and E. The delayed unit student surveys and interviews are located in Appendices F and G.

To understand the effects of using the OEE program on students' motivation and attitudes, I used pre and postunit surveys, instructor field observations and pre and postunit interviews. The pre and postunit surveys and pre and postunit interviews are described above and located in Appendices F-I. The instructor field observation notes were used to observe what I saw about the students and their learning in the OEE program and the classroom environment as well. The instructor field observation prompts are found in Appendix J.

As described above, I used pre and postunit surveys, pre and postunit interviews and instructor field observations to determine the effects of the OEE program on students' attitude and motivation to do classroom work after attending the OEE program. These data collection tools are located in Appendices F, G, H, I, and J respectively.

To determine the effects of teaching in a short-term learning environment on my thoughts of being an educator and my motivation, I used a teacher reflection journal with prompts, pre and posttreatment attitude survey, and nontreatment and treatment observations by colleagues. The teacher reflective journal was used to understand my feelings about my teaching and the delivery of the material to my students and is located in Appendix K. The pre and posttreatment attitude survey helped me to reflect on how I delivered the material to my students as well as addressing learning styles. These are located in Appendix L. Appendices M and N, contain the nontreatment and treatment observation prompts for colleagues. These prompts will aid colleagues in observing the delivery of the science concepts to the students.

I analyzed the preceding data by comparing pre and post treatment assessments as well as data treatment surveys to see what concepts that students have learned and

understood after attending the OEE program. Student interviews and surveys were compiled to determine students' preferred learning styles and preferred learning methods and show the benefit of the East Bay Outdoor School OEE program. I used my reflections and colleague observations to show how I saw my students in the lessons and how they are engaged in the lessons and their understanding of the material.

The time frame for the Capstone project is January 8, 2013 through February 22, 2013. A full timeline can be found in Appendix Q.

### DATA AND ANALYSIS

Data were collected in one nontreatment and two treatment units to determine the effect of an OEE program had on the students understanding of environmental science. Data were collected in accordance with the triangulation matrix such that each focus question and subquestion had resulting data to support the effect of OEE.

The data collected from the unit pre and postassessments allowed calculations of the percent change for the nontreatment and treatment units. The average scores, percent change and normalized gain scores can be found in Table 2.

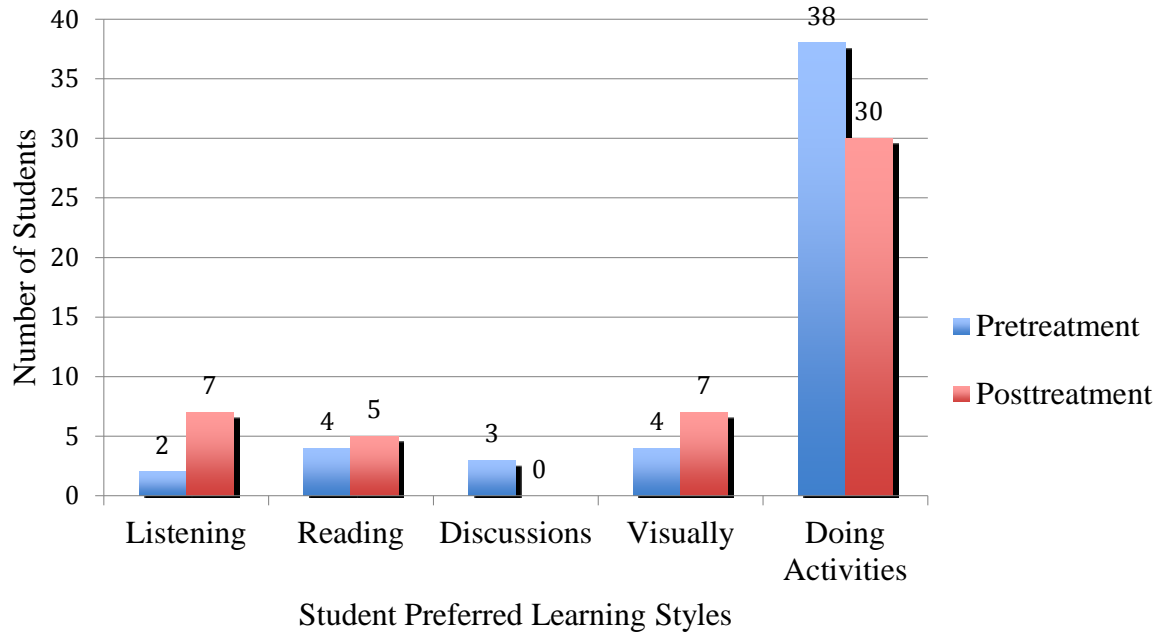
Table 2.  
*Average Scores of Unit Preassessments and Postassessments, (N = 64)*

Unit Data	Nontreatment Unit	Treatment Unit 1	Treatment Unit 2
Preassessment	3.12	4.55	1.17
Postassessment	5.2	10.73	5.03
Percent Change (%)	67	136	327
Normalized Gain Score	0.16	0.49	0.25

*Note.* All assessments out of 17 points.

Students showed gains in the nontreatment and the treatment units. When comparing the three units, the treatment units had higher gains than that of the nontreatment unit. This shows that the students responded well to the use of the OEE program for understanding science concepts

Pretreatment and posttreatment surveys were given to the students. I found a number of positive outcomes showing that the students in the OEE program had responded well to the hands-on teaching of the OEE program. Pre and posttreatment data regarding students preferred learning styles are represented in Figure 1.

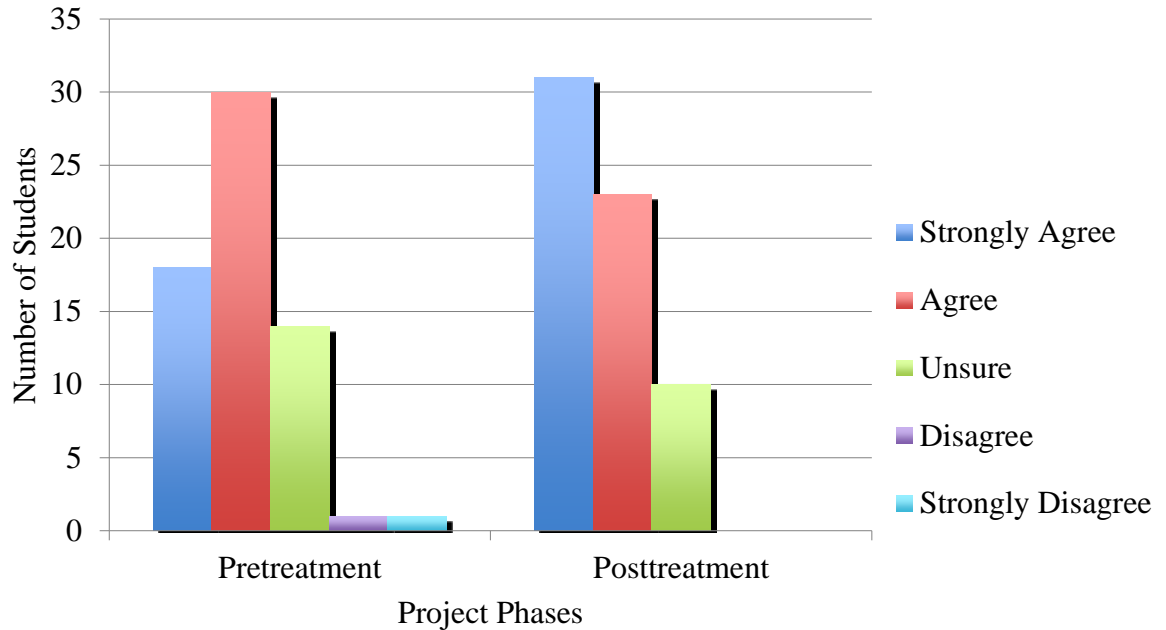


*Figure 1.* Student preferred learning styles pre and posttreatment, ( $N=51$ ).

The basis of teaching in the OEE program is a hands-on learning approach. When asked for their preferred learning styles prior to attending the OEE program, the answers were across the board including listening, reading, discussion, visual, and hands-on techniques. Both preunit and postunit survey results show that the majority of students preferred learning with hands-on techniques. After the OEE program, the number of

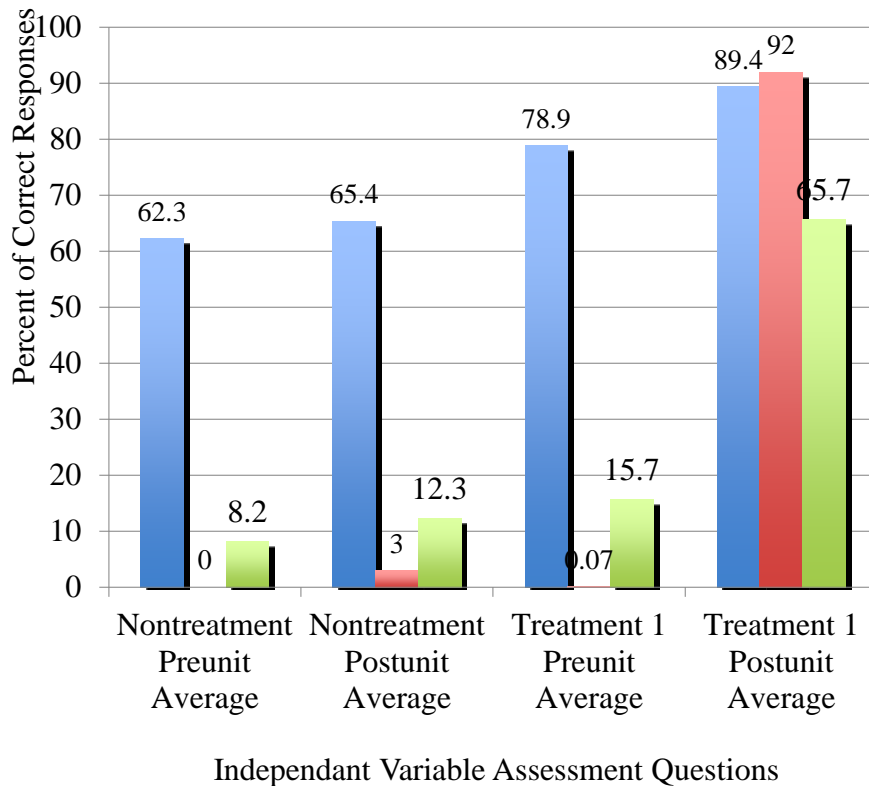
students preferring hands-on learning slightly decreased. All other categories increase by one to five students, except for discussion. This style decreased to zero students reporting this as their preferred learning style. Many students expressed that they thought hands-on learning was more fun, and not as boring as the others. One student said, “I like doing activities because I feel like I’m in the project and participating helps me understand more.”

Another indication of success with the OEE program was the student responses when they were asked if they liked learning science at school. The students responded using a Likert scale. The preunit and postunit surveys indicated an increase in enjoyment of studying science. The average response prior to attending the OEE program was 3.9. A score of 4 represented a response of Agree; this shows average response was just below and answer of Agree. After the OEE program, the average was 4.2, indicating just above Agree with an increase of 0.3 to the average when comparing the pre and postunit responses. The overall mean score on the preunit survey was 3.97; on the postunit the mean score was 4.21. Most notably was the large increase in the students who strongly agreed that they enjoyed learning science. The results are represented in Figure 2.



*Figure 2.* Student responses to enjoying learning science at school, ( $N=64$ ).

The following data from the nontreatment and treatment pre and postunit assessments indicates an increased knowledge and understanding of environmental science concepts. Figure 3 shows student response in regards to tangible environmental science concepts including defining the term geology, listing the major rock types, and describing the difference between how igneous rocks form versus sedimentary rocks.



- Define Geology
- List 3 Major Rock Types
- Explain how igneous rocks form versus sedimentary rocks

*Figure 3.* Percent of correct responses to preunit and postunit assessment questions, ( $N=38$ ).

In Figure 3, the majority of the students had a good base knowledge of what geology is prior to the treatment. The nontreatment unit data shows an increase of 3.1%. There was an increase of 10.5% after the treatment unit 1; I found that although the majority of the students knew what geology was, they lacked the knowledge in specific concepts prior to the OEE program. For example, the students' knowledge in the rock types from the nontreatment unit shows a 3% increase. The treatment unit shows an

increase of knowledge from less than 1% to 92% correctly indicating the major rock types. That is over 91% increase of knowledge in the students understanding. I also saw an increase of knowledge of how the rock types were formed. Student responses on the nontreatment increased 4.1% on the difference in how igneous rocks were formed versus how sedimentary rocks were formed; in the treatment it increased 50%. Students indicated that in the treatment, they liked the songs that were sung with vocabulary words and using the skittles as rocks helped them to visualize the formation of the rocks.

The interviews showed that students had increased knowledge in environmental science concepts. In Figure 4, the change in knowledge of the term plate tectonics.

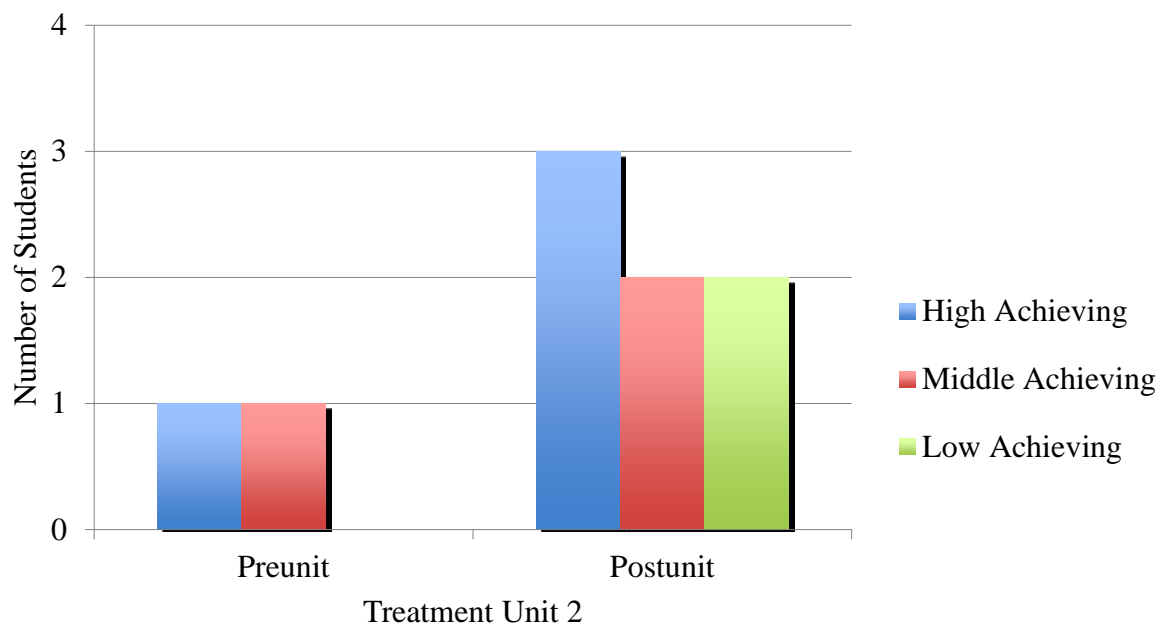


Figure 4. Correct responses in defining plate tectonics, ( $N=12$ ).

One of the most interesting conversations that I had was with one of my high-achieving students from Coyote Creek Elementary. In the preunit interview, when I asked him if there is anything else he would like me to know, he asked me if he could tell me something that he didn't like about school. When I responded yes, he spoke very

clearly about how much he enjoyed the OEE program because it made learning fun. He went on to say, “I don’t like state testing (at school) because it puts too much pressure on the students. They should test teachers or come watch them teach instead of testing students.” He gave me examples of his and his classmates’ anxiety over the state tests. I was amazed at the thought and insight into school policies. I know he is a high-achieving student, but I was still impressed by this fifth-grade student for being willing to speak his mind openly. He was a distinct outlier in the interviews. I spend limited time with my students and it was refreshing for a student to speak so openly about education.

In addition to understanding students’ learning of the basic environmental science concepts, I was interested in knowing if the OEE program had an effect on the students’ long-term memory. Postunit and delayed treatment student surveys, post and delayed unit interviews, and post and delayed unit assessments were used to collect data.

The delayed surveys indicate that 87% of students were able to effectively describe at least one environmental science concept that they learned while attending the OEE program. In response to the question, “What is one new thing you learned at the OEE program on the Cresta Blanca lesson”, students responded with a variety of answers that were covered in the lesson objectives. There were 42% who could name the three main rock types or how rocks are formed. Twenty-nine percent of the students could explain that Cresta Blanca formed from a landslide. Fifteen percent of students were able to describe erosion and weathering. They were able to define the terms or they gave a real-world example of it (the terms) that they saw while hiking. Two students focused on learning about plate tectonics; they explained the concept well and were able to define the term accurately.

The student interviews also showed a good rate of retention for environmental science concepts on the long term. Table 3 shows us how many correct responses the high, middle, and low- achieving students had when asked to define the term geology in the nontreatment and treatment interviews, as well as the retention rate of the information to the delayed interview.

Table 3  
*Retention for the Definition of Geology in Nontreatment and Treatment Interviews, (N=12)*

Student Achievement Categories	Nontreatment Unit			Treatment Unit 1		
	Postunit	Delayed	Percent Recalled	Postunit	Delayed	Percent Recalled
High Achieving	4	2	50%	4	3	75%
Middle Achieving	1	0	0%	3	2	67%
Low Achieving	0	0	0%	2	2	100%

*Note.* 12 students were interviewed; 4 in each achievement category.

Motivation and attitude plays a key role in the students' learning. Using the pre and posttreatment student surveys, I was able to understand how my students like to learn (Figure 5). They were asked how they prefer to learn science concepts. This is important to understand because the OEE is a hands-on learning experience. The students are able to see the Environmental Science concepts that they are learning with real-world examples.

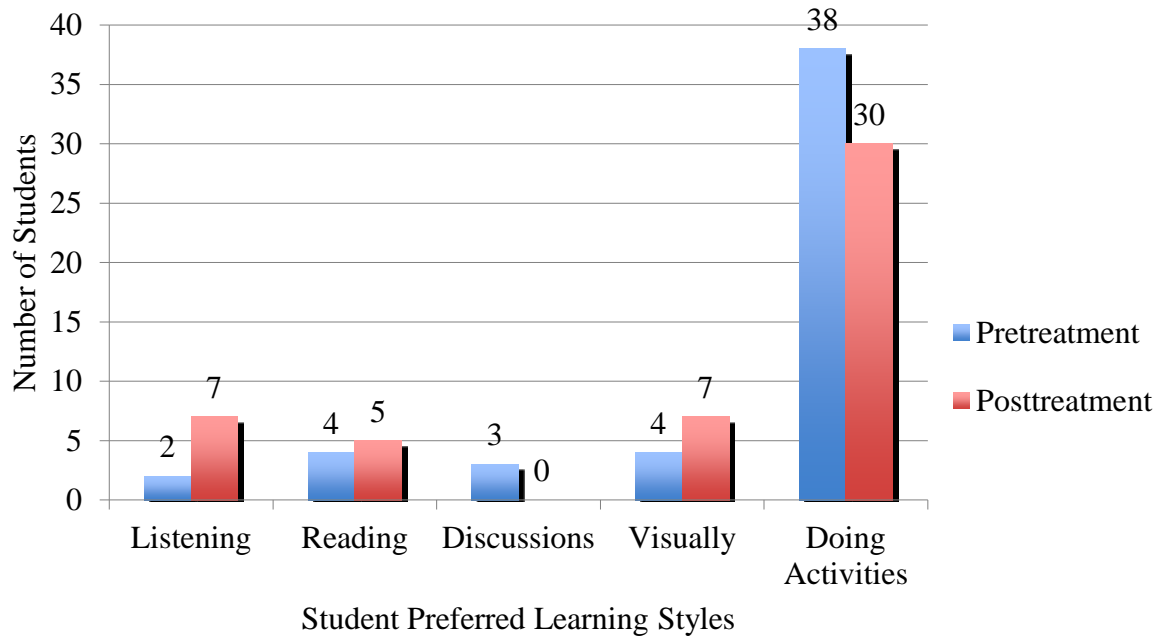


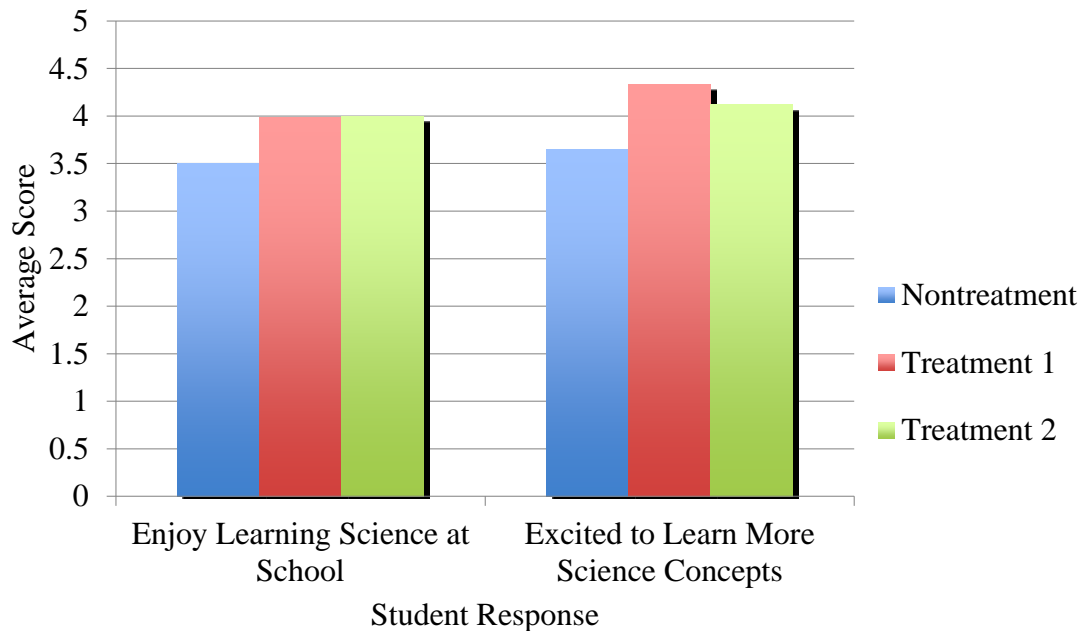
Figure 5. Students preferred learning styles, ( $N=51$ ).

The students reported that in their classrooms, most of the time they are learning by reading, teacher-led discussions, watching videos, and doing some experiments or watching the teacher do experiments. Looking at Figure 5, it is clear that the majority of the students prefer learning by doing activities. In the posttreatment assessment, there was a drop in preferred learning by doing activities, but a small increase in visual learning and listening. Overwhelmingly, 84% of students responded that doing activities was, “more fun”, “helps me learn more”, “helps me focus”, and “helps me understand the concepts presented to me”.

Student interviews showed increased student motivation. Again, students focused on the teaching at OEE being more hands-on, their preferred learning style. The students reflected that they enjoyed “actually trying things”, “experiencing science” and that it was “fun, interactive and shows you how science works”. When asked if after attending the OEE program they were more excited to learn science in school, 96% said yes. The

one outlier that responded no was a high-achieving student. He said it was because he “already loves science, so it didn’t affect me, but it probably did other kids.”

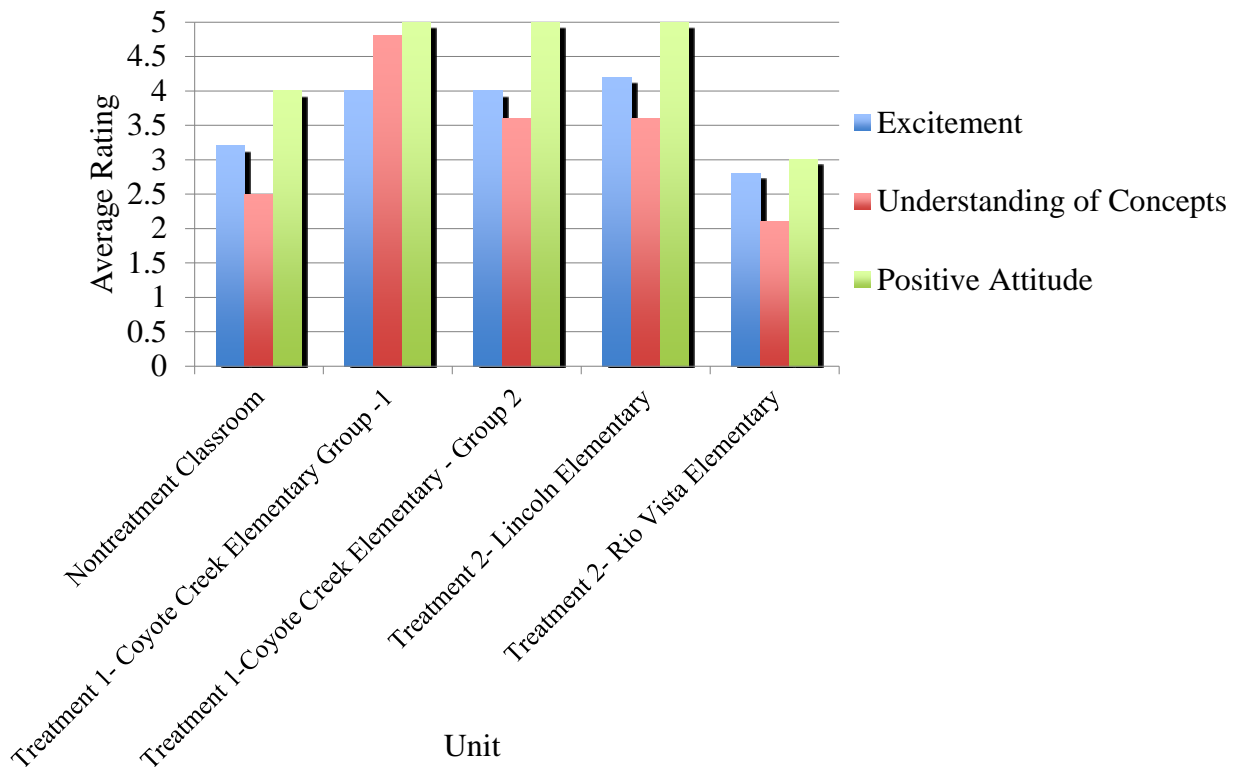
The preunit and postunit treatment surveys also showed the students interest in learning science concepts. Figure 6 shows the students’ interest in learning science in the classroom prior to attending the OEE program and after attending the OEE program.



*Figure 6.* Results from 2 targeted questions based on pre and postunit survey, ( $N=64$ ).  
*Note.* 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

On the postunit survey, when students were asked to indicate their motivation to learn more about science concepts at school after attending the OEE program, 75% either agreed or strongly agreed with the statement. From the results in Figure 6, it is evident that the majority of the students interviewed were interested in learning more about science after attending the OEE program. Five students that responded either disagree or strongly disagree. Some explained their answers by saying, “they preferred learning outside to the classroom” or “I like learning with technology more than being outside”.

Using the instructor field observations, I was able to compare my observations with the classroom teacher's observations. My gauge of the students' excitement about science concepts and understanding of science concepts while attending the OEE program was overwhelming. The rating for student excitement, understanding, and attitude are displayed in Figure 7.



*Figure 7.* Average instructor observation rating during units of students' excitement, understanding, and attitude.

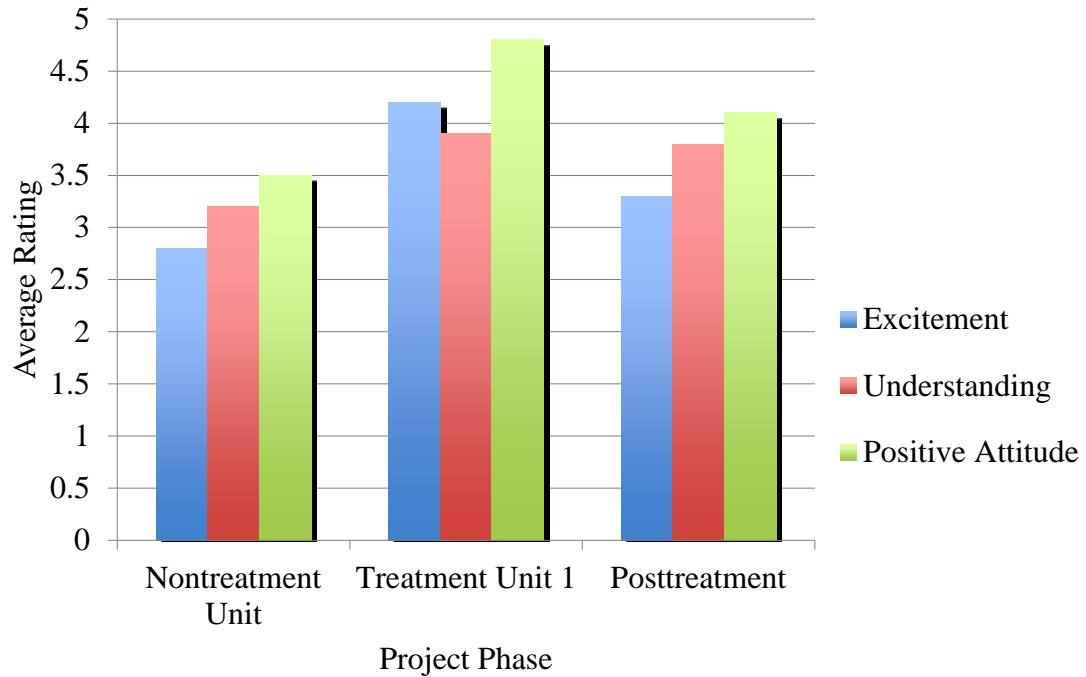
*Note.* 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

My observation notes indicated that in the classroom, students were fairly engaged in their learning and they displayed an exceptional attitude as a result of the rapport witnessed with their classroom teacher. There was some understanding of the concepts, but more so I witnessed the students regurgitating definitions from their science book. Of the four treatment groups, I witnessed three of the groups very engaged,

excited, positive, and inquisitive. The fourth group, Rio Vista School, was a bit less engaged with the learning. I noticed that their focus was more on the hiking experience than the learning of the science concepts that I was teaching. I noted in my journal after the treatment unit that the students struggled to answer questions. They were less engaged in the activities and more interested in observations on trail. For many of the Rio Vista students, it was their first time hiking and being outside in a large open space; as a result, the outdoors became a bit of a distraction to their learning of the particular science concepts.

The classroom teachers that attended the OEE program had similar observations that I did of the students. They reported that they saw their students trying new things at the OEE program and found that the students were very engaged with their learning process. Again, the Rio Vista teacher reported that he found his students were a bit distracted by the environment itself as well as the new outdoor experience in which the students were participating.

Using the instructor field observations, the classroom teacher from Coyote Creek School reported that his students were very engaged in learning science concepts after the OEE program. He said that they were able to reference their experiences at the OEE program and relate it to their classroom learning. The students referenced songs that we sang at OEE and it sparked their interest to learn more about the environmental science concepts being presented in the classroom. Results are reflected in Figure 8.



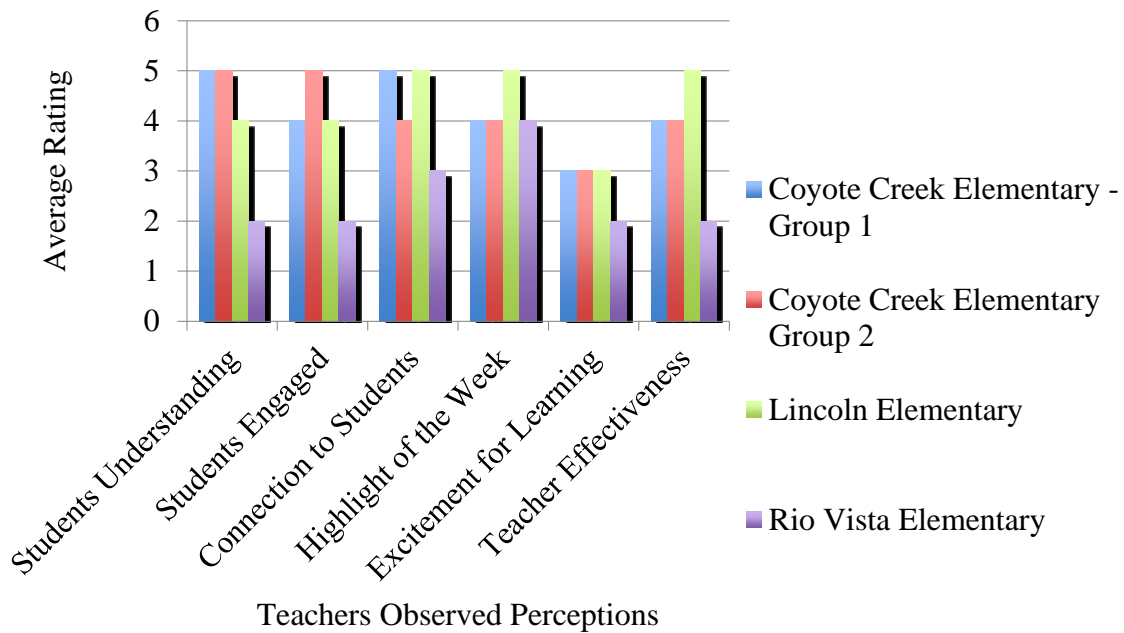
*Figure 8.* Average classroom teacher rating of observation rating during units of students' high level of excitement, understanding, and attitude.

*Note.* 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

As described above, in the student interviews 96% of the students reported a desire to continue to learn science concepts after attending the OEE program. One high-achieving student explained his answer by saying that it should be obvious. At OEE, he did more experiments and went to places to learn different science things. He said that he was excited before the OEE program, but now his excitement had increased.

Finally, I determined the effects of the short-term learning environment on my thoughts of being an educator and my motivation. My reflection journal played an important role in determining my attitude and motivation in teaching at the OEE program. (Figure 9) I found that when I was excited about the science concepts and actively engaged with my students and my teaching, I was able to help my students better understand the concepts I was teaching. Reflecting on teaching the Rio Vista students, I

noted in my journal that they struggled to stay focused and were easily distracted by the environment. I found that I struggled with their lack of focus. It affected my teaching abilities and I feel that I gave them less effort than I had the other students that were more engaged with the lessons. I noted in my journal, today was an “off” day for me. I also wrote, that I need to remember to modify my teaching to meet the students at their level and to find a way to reconnect with the students when I am feeling distracted. I found that the more effort I was able to give to my students, they were more likely to put forth the same effort into learning.



*Figure 9.* Average teacher rating from reflection journal during treatment units of students’ level of understanding, engagement, connection with teacher, student week highlight, excitement and teacher effectiveness.

*Note.* 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

My attitude surveys expressed the same results. I found that the students from the Coyote Creek groups as well as the Lincoln Elementary group were more excited and engaged. This influenced my attitude and made me a more effective of a teacher. For all of the treatment groups, there was a focus on experiential, hands-on, inquiry based

learning. The difference between the Rio Vista group and the others was that I gave them less effort in my teaching and when they were distracted, I was less likely to find a way to get them back on topic. I wrote in my journal that the students and I didn't connect well in this lesson and that their distractions lead to my distraction and lack of focus on teaching the science concepts. I do believe that the students still had a positive experience at the OEE program, but I think that it was more about finding a comfort level with nature as opposed to learning the intended science concepts.

Being observed by a colleague was also important to understanding my attitude and motivation in teaching. During the observation, my colleague found that overall I was engaged with my students and excited about teaching the science concepts. She found a particular connection between the Lincoln students and me. She observed that I continued to return to key concepts to assure the ESL students understood the concepts. She noted that my enthusiasm in singing the rock song was inspiring and said that she overheard the students singing the song later on in the day.

#### INTERPRETATION AND CONCLUSION

The purpose of this research was to determine if an OEE program has an effect on students understanding of environmental science concepts. I learned that the OEE program had a positive effect on the students learning and understanding of these science concepts. Prior to the treatment units, students had a basic understanding of geology and specific geological concepts. The surveys' showed students' ability to define geology after the treatment unit increased. With no prior background knowledge in rock types prior to the treatment, the most significant increase in knowledge was seen with naming the major rock types after the treatment. This increase of knowledge from use of the OEE

program is higher than the nontreatment unit. The treatment units were effective in solidifying and expanding this knowledge in both the short-term and the long-term memory of the students. The effects of OEE on student attitude and motivation were also determined. Many students reported that they enjoyed being a part of their learning both on the surveys and in the interviews. They felt that the hands-on approach of the OEE program was well suited to help them learn the environmental science concepts. Overall, the students liked being engaged with their learning and improved scores on the surveys, assessments, and the interviews after the treatment units demonstrated this success.

The Rio Vista students did struggle with staying engaged during the treatment unit. They were quite distracted by the natural environment around them. I feel that this was a result of being in a large, open, natural space. These students live in an urban environment and rarely get to visit places like where the OEE program takes place. For this group of students, I needed to reframe my expectations. It is important to note that as the teacher, I struggled to keep them on task. I noted in my field observations that the lesson became a bit more about an introduction to nature instead of understanding the environmental science concepts. At the time, this was a decision that was made to work with the students and their needs. I would work differently in the future with other groups that had similar issues. Since I was a bit less engaged than normal, it effected my motivation to pull them back in in order to focus on science concepts.

The students also self-reported that after participating in the OEE program, they were more excited about learning science in their classrooms. For some of the students, they have a limited amount of time for their science classes at school. The OEE program peaked their interest and it has translated into motivation to get the most out of their

opportunities in the classroom as well as through learning on their own and from family members.

I found this project to be an interesting insight into my own teaching when it comes to attitude and motivation. I often struggle to understand if what I do makes a difference in my students' lives. I see them for such a short period of time and have never seen the impact of the OEE program on the students' comprehension of the science concepts that I teach. I often get letters from students telling me what a fun experience they had, but no solid data on their learning. It is helpful to have data that supports that my approach to teaching in the OEE program is effective for the students learning and understanding of the concepts and that they are actually motivated to learn more about science back at school. I also became abundantly aware that when I am teaching, my efforts and attitude affects my students understanding of what I am teaching and vice versa. I have been able to continue to reflect on this and have been more aware of how I carry myself while I am teaching. I realize how important the program is to the students learning and I make sure to keep that at the forefront of my mind when meeting with my students. It is so important that they get the best of me as a teacher and in turn I can get the best of them as students. The same holds true for my students' attitude affecting me. I found when my students are excited and eager to learn, I can take on that energy and excitement. Sometimes when they are distracted I find myself with a roaming eye and mind as well. It is important to utilize the best energy in the group, whether it is all of the students, just a handful of kids, or even my own energy and attitude. I found that working together to bring that excitement to science is where I want to be when I am teaching.

When I looked closely at this process, there are a few things that I would change had I to do over again. I found the most challenging part of the research was relying so heavily on the classroom teachers to assist in data collection. I would actually take the time to go to the classrooms myself after the OEE program for the posttreatment surveys and interviews. There were many extra steps trying to get the information from the classroom teachers. One other aspect was the specific language on the student surveys and assessments. I found that many of the students struggled with understanding what some words meant, which added confusion on how to answer the questions. I would want to make sure that the language was at the level of the fourth and fifth-graders that I teach. Of course, as stated above, using the positive energy and attitudes of the group to bring everyone to a love of learning and understanding of the science concepts that I am teaching. Realizing that it is ok for the students to be a bit distracted with teachable moments, but being able to rein them back in is important for the experience as well.

#### VALUE

The value of this study presents the importance of the OEE program to my students, my colleagues as well as classroom teachers. It is able to give me an insight to what my students gain from attending an OEE program as a part of a school field trip. It is becoming more and more challenging for schools to attend such programs because of budget cuts. Evidence like this will help support the need for such field trips. I found that the students' knowledge and understanding of the environmental science increased as well as their excitement to learn more science back at school. The topics that I teach at East Bay Outdoor School are aligned to the California State Standards, which the students get tested on each May. Being able to help solidify concepts with the hands-on

approach is valuable for both the students and the schools, as it will reflect in their students test scores. My knowledge of the data and the impact of the OEE program continue to motivate me to deliver a quality education program to my students week after week.

The OEE program acts as a support to students' and what they are learning in their classrooms. It helps them to develop understanding of concepts and expand their learning. I would like to see classroom teachers implement more OEE-like teaching philosophies. Many of the students enjoyed the hands-on learning and it helped them to comprehend the concepts that I was teaching. Teachers should consider and include these hands-on activities in addition to classroom lectures, discussions, and textbook activities. I think educators need to be more aware of students' preferred learning styles and work to address them as much as possible on a daily basis.

The next steps in this research could be to look at an even longer-term impact on the students whom attend the OEE program. My data show positive change in students during and two weeks following the program. I think that it would be interesting to follow a group of students over a longer term and see what effects the OEE program has on their learning and retention of the environmental science concepts, as well as their attitude and motivation towards learning science in the classroom. It would also be interesting to see how the OEE program affects students and their conservation efforts after attending the program. Many students say that they want to work at an OEE program when they are loading the buses to leave East Bay Outdoor School. It would be interesting to see how many students go into the field of OEE or even another science career.

I think one of the most interesting things that I found in this process was in regards to the student interviews. I was surprised to see how honest and open the students were when talking with me. They were excited to be a part of this process and in fact I had students that were not part of the interviews asking to be interviewed. I found that my students have a voice when it comes to how they want to learn and as an educator it is my job to listen to them. They want to express their feelings and to let educators know what helps them learn. This has opened my eyes to working with my students. I am more engaged on a daily basis and working towards being aware of their learning needs.

I found it both rewarding and challenging working with the classroom teachers. Usually, the only contact that I have with the teachers is while their students are attending the OEE program. In utilizing their help with assessments, surveys and interviews in their classrooms, I was able to establish a different relationship that will likely continue to improve as their schools return to the OEE program year after year. I found that they were surprised that I was working on a Master's degree, but were very eager to help. On the flip side, it was a challenge because teachers already have so much on their plate in managing their classrooms. It sometimes took reminders to them to return the assessments to me. And while it was challenging, it was completely understandable.

A big eye opener with this project was my thoughts on working in the OEE field versus teaching in a traditional classroom. While I was observing the classroom lesson, I was able to see in myself that I am content and happy to be able to teach my students outside. Right now, I can't imagine teaching in a classroom environment. The excitement that comes along with the challenges of teaching different students each week

is well worth it. And I am happy to find that what I do does make a difference in my students and their learning of science concepts.

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APPENDICES

APPENDIX A

NONTREATMENT- CLASSROOM LESSON PLAN

## **Classroom- Rock Types/ Rock Cycle**

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### ***Objectives:***

Students will be introduced to and understand vocabulary words related to rocks and rock cycles

Students will utilize slides to practice note-taking skills

### ***Materials:***

Textbook

Science Workbook

Smart Board/ Slides

Pencils/ Notebooks

### ***Procedure:***

Introduction: Review of the previous day's homework. Make corrections to use as a study guide.

#### **Activity: Vocabulary Review**

Quick review of previous days vocabulary; teacher speaks the words aloud, students repeat, then a volunteer from the class shares the definition with everyone.

#### **Activity: Vocabulary Introduction**

Teacher reads paragraphs from the textbook, students say aloud bolded words. Teacher clarifies pronunciation of words and vocabulary definitions. Students read excerpts from the book aloud. Students take notes from the board on vocabulary words.

**Debrief:** Students participate in matching exercise using the Smart board. Random students are chosen to match words and definitions in front of the classroom.

#### **Activity: Vocabulary Review**

Teacher reads vocabulary words aloud, students use textbook to assist in answering the questions.

**Debrief:** Teacher asks questions, students respond aloud to class to a neighbor.

### **Wrap it up:**

Work on homework in small groups.

APPENDIX B

TREATMENT I LESSON PLAN- ROCK TYPES/ ROCK CYCLE

## **Cresta Blanca- Rock Types/ Rock Cycle**

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### ***Objectives:***

Students will understand differences between rock types and how the different rocks form a cycle

Students will understand the difference between weathering and erosion.

Students will understand how Cresta Blanca was formed.

Students will feel a sense of accomplishment for completing a difficult 3-mile hike

### ***Materials:***

White board & markers

Skittles

Rock samples

Sugar cube

WE chamber

### ***Procedure:***

Introduction: When was a time you felt like you did something really challenging? Look at Cresta Blanca, how far away do you think it is? How many of you have gone on a 1mile/2mile/3mile hike? Today that's what we're doing!

### **Activity: Rock Buddy**

Have students grab a rock from the ground that they like. Study the rock. What do you notice about it? What type of rock do you think it is? Keep it with you for the hike.

### **Activity: Weathering/ Erosion Chamber**

This is a small mountain! Why might I say that? Introduce weathering/erosion and explain that we are going to be putting this mini-mountain through millions of years of weathering. Brainstorm what this might mean (rainstorms, wind, etc.). I challenge everyone to find at least 3 examples of weathering/erosion on this hike.

**Debrief:** At the end, what does this look like now? What happened? Did we see any of this today on our hike?

### **Activity: Skittles rock cycle**

Introduce rock cycle with skittles to demonstrate how rocks can change from one type to another.

Liquid skittle = Igneous

Solid skittle (as we know it) = Sedimentary

Two skittles chewed together = Metamorphic

**Debrief:** What are some examples of where we might see the rock cycle in action?

### **Activity: Buddy hike to CB overlook**

Imagine this story is about *your* rock. Introduce your rock and why you like it to your buddy.

**Debrief:** Have students' pair up to make fours and ask to discuss what happened on the cards. Illustrate with whiteboard. Will this happen to your rock? How? Which parts match up with our skittles? Inspect Rock samples. Sing Rock Song about Rocks

Activity: Rock buddies

**Debrief:** When leaving rocks exactly where we found them (at the end of the hike), play rock identification game. Was that difficult? Easy? Why? Might a rock travel that far naturally? What else might happen to your rock in the future?

**Wrap up:**

Have students explain rock types/ rock cycle. Use white board to illustrate what they explain.

Share our found examples of weathering/erosion.

APPENDIX C

TREATMENT 2 LESSON PLAN- PLATE TECTONICS

## **Cresta Blanca- Plate Tectonics**

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### ***Objectives:***

Students will understand what plate tectonics means and what a fault is.  
 Students will understand how to read a topographic map and interpret it.  
 Students will understand how understand the concepts divergent fault, convergent boundaries and transform fault in relation to plate tectonics.  
 Students will feel a sense of accomplishment for completing a difficult 3-mile hike

### ***Materials:***

Whiteboard & markers  
 Topographic map of the area  
 California Fault visual  
 Wax paper, graham cracker, peanut butter

### ***Procedure:***

Introduction: When was a time you felt like you did something really challenging? Look at Cresta Blanca, how far away do you think it is? How many of you have gone on a 1mile/2mile/3mile hike? Today that's what we're doing! And we are going to learn a bit about how the land around us was formed.

### **Activity: California Topographic Maps**

We are going to take a look at these maps to learn a bit about how the land around us was shaped. What do you notice about the maps? Why are topographic maps useful to us? Let's use this marker and my hand to understand how a mountain range can be interpreted into a topographic map.

### **Activity: Faults- Definitions and Tectonic Waltz**

What is a fault? What faults are in this area and how did they help shape these mountains and valleys? The most famous fault in this area is the San Andres Fault; the closest major fault to us is the Hayward Fault. Let's learn about how the land moves... define divergent fault, convergent boundaries and transform fault.

**Debrief:** Tectonic Waltz. Sing and dance to the tectonic waltz to reinforce definitions.

### **Activity: Bipity-Bipity Bop Tectonics**

Play Bipity-Bipity Bop Tectonics. Students use actions for divergent, convergent and transform faults to reinforce definitions. Last person standing is King or Queen of faults.

### **Activity: Faults with Food**

Check for students understanding of faults with graham crackers and peanut butter fault simulation. Describe each fault type and demonstrate how they move with the graham crackers on the wax paper.

**Debrief:** What type of faults formed the Sierra Mountain Range? The Coast of California? The area around us?

**Wrap up:**

Have students explain faults and plate tectonics. Use California maps to understand the local landforms and reinforce vocabulary.

APPENDIX D

NONTREATMENT AND TREATMENT 1 PRE, POST, AND DELAYED UNIT  
STUDENT ASSESSMENTS

**Preunit, Postunit, and Delayed Assessment- Rock Types/ Rock Cycle:**

1. Define geology.
2. What are the three major rock types?
3. Classify the following rocks into one of the major rock types:
  - a. Limestone:
  - b. Sandstone:
  - c. Gneiss:
  - d. Pumice:
4. Explain the difference between how igneous rocks form versus how sedimentary rocks form.
5. Draw a simple diagram of the rock cycle.

*Respond to the following items by circling the response that most closely reflects your opinion: strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD)*

6. I understand that rocks can change forms via the Rock Cycle.

SA            A            U            D            SD

Explain.

7. I believe that weathering and erosion are distinctly different processes that can change landforms.

SA

A

U

D

SD

Explain

APPENDIX E

TREATMENT 2 PRE, POST, AND DELAYED UNIT STUDENT ASSESSMENT

**Preunit, Postunit, and Delayed Assessment- Plate Tectonics:**

1. Define geology.
2. What are two examples of faults in the California Bay Area?
3. Explain the difference between transform fault and subduction.
5. Draw a simple diagram using the following terms: convergent boundary, divergent fault, and transform fault. Label each item on your drawing.

*Respond to the following items by circling the response that most closely reflects your opinion: strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD)*

6. I understand that landforms can change shape as a result of plate tectonics.

SA            A            U            D            SD

Explain.

7. I believe that earthquakes can happen as a result of plate tectonics.

SA            A            U            D            SD

Explain

APPENDIX F

PREUNIT STUDENT SURVEY

**Preunit Student Survey:**

1. What is your favorite subject at school? Explain.
2. What is your favorite thing that your teacher taught you this year in science class?
3. What did your teacher do to help you learn your favorite topic?
4. How do you prefer to learn science? Circle the best answer for you.

A. Listening      B. Reading      C. Discussions      D. Visually      E. By  
doing activities

Explain your answer.

5. What do you think the difference between learning at school versus learning at the Outdoor Education program will be? Explain.

*Respond to the following items by circling the response that most closely reflects your opinion: strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD)*

6. While in science class, I believe that my teacher teaches class the way that I like to learn.

SA      A      U      D      SD

Explain.

7. I enjoy learning science concepts while at school.

SA

A

U

D

SD

Explain.

APPENDIX G

POST AND DELAYED UNIT STUDENT SURVEY

**Post and Delayed Unit Student Survey**

1. What is your favorite subject at school?
2. What is your favorite thing that your teacher taught you this year in science class?
3. What did your teacher do to help you learn your favorite topic?

4. How do you prefer to learn science? Circle the best answer for you.

- A. Listening      B. Reading      C. Discussions      D. Visually      E. By  
doing activities

Explain your answer.

5. What was your favorite thing about the OEE program? Explain.

6. What is one thing new you learned on the Cresta Blanca lesson at the OEE program.

Explain.

7. What did your Naturalist do to help you learn this topic? Explain.

8. What do you think the difference between learning at school versus learning at the Outdoor Education program was? Explain.

*Respond to the following items by circling the response that most closely reflects your opinion: strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD)*

9. While at school, I believe that my teacher teaches class the way that I like to learn.

SA            A            U            D            SD

Explain.

10. I enjoy learning science concepts while at school.

SA            A            U            D            SD

Explain.

11. After attending the Outdoor Education program, I am excited to learn more about science concepts at school.

SA            A            U            D            SD

Explain.

APPENDIX H

TREATMENT 1 PREUNIT INTERVIEWS

**Preunit Interview Questions:**

1. What is your favorite subject at school? Explain your answer.
2. Do you think there is a difference between learning at school and learning at the OEE program? Explain your answer.
2. What can a teacher do to help you understand material better in class? Explain.
3. What can a teacher do to help you retain the material after you have learned it in class? Explain.
4. Are you excited to learn science at school? Explain.
5. Define the term geology.
6. What are the three major rock types? Can you give me an example of each type?
7. Draw a simple diagram of the rock cycle.
  
8. Is there anything else I should have asked you?

APPENDIX I

TREATMENT 1 POSTUNIT INTERVIEW QUESTIONS

**Postunit Interview Questions:**

1. What was your favorite class at school? Explain.
2. Do you think that there is a difference between learning at school and learning at the OEE program? Explain.
3. What can a teacher do to help you understand material better in class? Explain.
4. What can your teacher do after a class to help you retain the material after you have learned it in class? Explain.
5. Do you think that the OEE program made you more excited to learn science back at school? Explain.
6. Define the term geology.
7. What are the three major rock types? Can you give me an example of each type?
8. Draw a simple diagram of the rock cycle.
  
9. Is there anything else I should have asked you?

APPENDIX J

TREATMENT 2 PREUNIT INTERVIEWS

**Preunit Interview Questions:**

1. What is your favorite subject at school? Explain.
2. Do you think there is a difference between learning at school and learning at the OEE program? Explain your answer.
2. What can a teacher do to help you understand material better in class? Explain.
3. What can a teacher do to help you retain the material after you have learned it in class? Explain.
4. Define the term plate tectonics.
5. What are the different fault types? Can you give me an example of two faults in the Bay Area?
6. Draw a simple diagram of how the Earth's plates move to change land forms.
  
7. Is there anything else I should have asked you?

APPENDIX K

TREATMENT 2 POSTUNIT INTERVIEWS

**Postunit Interview Questions:**

1. What was your favorite subject at school? Explain.
2. Do you think that there is a difference between learning at school and learning at the OEE program? Explain.
3. What can a teacher do to help you understand material better in class? Explain.
4. What can your teacher do after a class to help you retain the material after you have learned it in class? Explain.
5. Do you think that the OEE program made you more excited to learn science back at school? Explain.
6. Define the term plate tectonics.
7. What are the different fault types? Can you give me an example of two faults in the Bay Area?
8. Draw a simple diagram of how the Earth's plate move to change land forms.
9. Is there anything else I should have asked you?

APPENDIX L

INSTRUCTOR FIELD OBSERVATION PROMPTS

**Instructor Field Observation Prompts:**

Phase of lesson: beginning, middle, or end

1 = Strongly Disagree 2 = Disagree 3 = Not Sure 4 = Agree 5 = Strongly Agree

1. Did the students get excited about/ understand that science concepts that were presented to them? (Either in the classroom before the trip or at the OEE program.)

1 2 3 4 5

Explain.

2. Did the students answer questions about the science concepts that were presented to them? (Either in the classroom before the trip or at the OEE program.)

1 2 3 4 5

Explain.

3. When the students returned to the classroom, was there interest in science class (after the OEE program)?

1 2 3 4 5

Explain.

4. Did the students ask/ answer questions about the science concepts that were presented in the classroom? (After the OEE program.)

1 2 3 4 5

Explain.

5. Anything else you observed?

APPENDIX M

TEACHER REFLECTION JOURNAL WITH PROMPTS

**Teacher Reflection Journal with Prompts:**

1 = Strongly Disagree 2 = Disagree 3 = Not Sure 4 = Agree 5 = Strongly Agree

1. How did you feel about the group today? Did they understand what you were teaching?

Did you need to modify your lessons for them to understand the science concepts? 1 2

3 4 5

Explain.

2. Where the students actively engaged in the lessons that you taught? 1 2 3 4 5

Explain.

3. Did you connect with all the students in your class today? 1 2 3 4 5

Explain.

4. What do you think was the highlight of your students' education experience this week?

1 2 3 4 5

Explain.

5. Was there anything that you think you could have done better while teaching your students today? 1 2 3 4 5

Explain.

6. What do you think was the most important take-home topic that you taught this week?

1 2 3 4 5

Explain.

7. How did you help instill excitement for learning in your students? How did you encourage them to have the same excitement back at school? 1 2 3 4 5

Explain.

8. What do you think your students will do with what they learned this week? How do you think the OEE program effect your students' future learning? 1 2 3 4 5

Explain.

9. Anything else you want to add?

APPENDIX N

PRE AND POSTUNIT TEACHER ATTITUDE SURVEY

**Pre and Posttreatment Teacher Attitude Survey:**

*Respond to the following items by circling the response that most closely reflects your opinion: strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD)*

Today I put my best efforts and energy into teaching my students.

SA            A            U            D            SD

Explain.

I used primarily experiential, hands-on, inquiry based learning with my students.

SA            A            U            D            SD

Explain.

I think that students learn and understand my lessons when I teach to multiple learning styles.

SA            A            U            D            SD

Explain.

I think that if I am excited about a science concept that I am teaching, my students will be too.

SA            A            U            D            SD

Explain.

I took the time to get to know as much as I could about my students this week.

SA            A            U            D            SD

Explain.

I think that my students will be able to retain the science concepts I taught because of the delivery of the material.

SA            A            U            D            SD

Explain.

It is hard to teach students for a short period of time such as a week.

SA            A            U            D            SD

Explain.

I think working at the OEE program provides a worthwhile experience for my students:

SA            A            U            D            SD

Explain.

I think that working at the OEE program provides me with a worthwhile teaching experience.

SA            A            U            D            SD

Explain.

I think it would be easier or more worthwhile to be a classroom teacher.

SA            A            U            D            SD

Explain.

APPENDIX O

NONTREATMENT OBSERVATION BY COLLEAGUE

**Nontreatment Observation by Colleague:**

1 = Strongly Disagree 2 = Disagree 3 = Not Sure 4 = Agree 5 = Strongly Agree

1. Did the students get excited about/ understand that science concepts that were presented at the classroom? 1 2 3 4 5

Explain.

2. Did the students ask/ answer questions about the science concepts that were presented in the classroom? 1 2 3 4 5

Explain.

3. Where the majority of the actively engaged in the science lesson? 1 2 3 4 5

Explain.

4. Did the teacher address many learning styles while teaching? 1 2 3 4 5

Explain.

5. Anything else you observed?

APPENDIX P

TREATMENT OBSERVATION BY COLLEAGUE

**Treatment Observation by Colleague:**

1 = Strongly Disagree 2 = Disagree 3 = Not Sure 4 = Agree 5 = Strongly Agree

1. Did the students understand what was being taught in the lesson? Did the Naturalist need to modify your lessons for them to understand the science concepts?

1 2 3 4 5

Explain.

2. Where the students actively engaged in the lessons that were taught? 1 2 3 4 5

Explain.

3. Did the Naturalist connect with all the students in her group? 1 2 3 4 5

Explain.

4. What do you think was the highlight of the lesson for the students? 1 2 3 4 5

Explain.

5. Was there anything that you think the Naturalist could have done better while teaching today? 1 2 3 4 5

Explain.

6. How did the Naturalist help instill excitement for learning in the students? How did she encourage them to have the same excitement back at school? 1 2 3 4 5

Explain.

7. Anything else you want to add?

APPENDIX Q

PROJECT TIMELINE

**Project Timeline:**

January 8: Nontreatment Unit- Classroom Observation- Nontreatment Observation

January 10: Preunit Assessments Administered in All School Classrooms

January 15- 18: Treatment Unit 1 at OEE Program- Coyote Creek I

January 15: Preunit Student Surveys/ Preunit Student Interviews

January 17: Treatment Unit – Rock Types/ Rock Cycle and Instructor Field Observations

January 18: Postunit Student Surveys/ Postunit Student Interviews

January 22-25: Treatment Unit 1 at OEE Program- Coyote Creek II

January 22: Preunit Student Surveys/ Preunit Student Interviews

January 24: Treatment Unit – Rock Types/ Rock Cycle and Instructor Field Observations

January 24: 1<sup>st</sup> Observation by Colleague

January 25: Postunit Student Surveys/ Postunit Student Interviews

February 1: Treatment Unit 1- Delayed Assessment and Postunit Delayed Student Interviews- Coyote Creek I

February 5-8: Treatment Unit 2 at OEE Program- Lincoln Elementary

February 5: Preunit Student Surveys/ Preunit Student Interviews

February 7: Treatment Unit – Plate Tectonics and Instructor Field Observations

February 7: 2<sup>nd</sup> Observation by Colleague

February 8: Postunit Student Surveys/ Postunit Student Interviews

February 8: Treatment Unit 1- Delayed Assessment and Postunit Delayed Student Interviews- Coyote Creek II

February 12-15: Treatment Unit 2 at OEE Program- Rio Vista Elementary

February 12: Preunit Student Surveys/ Preunit Student Interviews

February 14: Treatment Unit – Plate Tectonics and Instructor Field Observations

February 15: Postunit Student Surveys/ Postunit Student Interviews

February 15: Treatment Unit 2- Delayed Assessment and Postunit Delayed Student Interviews- Lincoln Elementary

February 22: Treatment Unit 2- Delayed Assessment and post-unit Delayed Student Interviews- Rio Vista Elementary