

HOW DOES INQUIRY-BASED LEARNING AFFECT ATTITUDES TOWARDS
SCIENCE OF FIRST GRADE ENGLISH LANGUAGE LEARNERS?

by

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Douglas Wayne Lymer

July 2013

DEDICATION AND ACKNOWLEDGEMENTS

I want to thank my friends and family over the last three years during graduate school. Mom, I may have not called often enough. As for my daughter, thanks for listening to me go on about the things I have learned and what makes me excited about teaching.

During the past few years while I have been pursuing my master's degree as well as preparing for this research project, my father, David Leroy Lymer, was diagnosed with prostate cancer. After months of radiation, remission, the reappearance of cancer and twenty-two chemotherapy treatments, David suffered a lengthy decline in health. During October 2012, David Lymer won his prize leaving his cancer-riddled body in the hospital bed. Dad, thanks for your continued, silent support. See you in heaven.

Thanks especially to my wife. Through it all, you are still my biggest fan. Your support, patience and love have been beyond reciprocation.

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ABSTRACT

English Language Learners in fourth and fifth grade often express poor attitudes towards science class due to limited English. Lack of English rather than science content knowledge seems to be the deterrent for their success on formal science assessments. I worked with first grade English Language Learners using inquiry-based learning to improve students' attitudes towards science class. Students were engaged in open-ended, student-centered language building activities. Students constructed their own knowledge in teams and explored topics they felt interesting. Quantitatively there was not a significant difference in the students' academic performance. Comparing the inquiry-based learning with a more "traditional" teacher-centered, scripted approach, there was a statistically significant difference in the students' attitudes towards the inquiry-based lessons. English Language Learners need this less formal approach where they can work together to build their knowledge. Working cooperatively, the students practice the informal science language associated with the content without the added pressure of speaking up in front of the teacher or the whole class. Teachers of English Language Learners should expand their own content knowledge as well as work towards being an inquiry-based teacher to provide less stressful learning environment for their Limited English students.

INTRODUCTION AND BACKGROUND

Project Background

Teaching Experience & Classroom Environment

I have been a primary teacher for nineteen years, always working with bilingual students. The parents and children primarily speak Spanish in the home. I have taught first through third grade with twelve of those years working with first grade. I have seen the demographics change from 28% bilingual to about 45%. Our school is a Title I campus with 78% of the population qualifying for free or reduced lunch. There is also a large population of English Language Learners (ELL's). We have students from Pakistan, Korea, Greece, Viet Nam, India, Jordan, Somalia and many countries of Latin America. In early elementary our focus is really on language development. Even though the content that I teach is math and science, in actuality I teach vocabulary (formal and informal) with each lesson. When students are becoming acquainted with the new topic of curriculum, we need to offer informal time to "play." During this time students can begin to grasp the concept in a non-verbal way and assign meaning in the minds long before we teach formal math or science vocabulary.

The Texas legislators designed new standards for science that recommends that 60% of activities in science should be hands-on or inquiry based. With that said, for many years, teachers have used traditional lecture, worksheets, and questions after reading, memorization as well as the all-time favorite of "drill and kill." I need not mention that it might be safe for a teacher of elementary, uncomfortable with science curriculum to just teach in a lecture style, and not really understanding the material. We have a test for which we must prepare. We tell students what they need to know and they have to "learn" it. So many times students will not remember our material the next day. I

am personally concerned about all of the students I have taught in my career. Have I given them ample opportunities to experience science? Have I spent too much time reciting all that I know about the topic? Even though I personally enjoy science and love teaching science, what “I know” is not what is important.

I have two groups of twenty students. My language arts partner and I switch groups at midday. As a whole, my afternoon group has lower reading levels than the morning group. The afternoon class is 50% male while my morning class is 33% male. I have observed that students in the afternoon generally respond better to less formal instruction due to short attention spans. Coincidentally, this is also after lunch, recess and physical education or fine arts.

I have noticed over the years that the students’ academic success is often diminished due to the English Language Learners’ limited vocabulary. I engage in on-going contact with teachers on my campus from other grade levels who work with English Language Learners (ELL’s). They assure me that they are aware that what is best for students is inquiry-based learning and direct instruction of science vocabulary. They also share that more than half of their ELL’s have such a limited English background which makes it extremely difficult for them to be successful, especially in science. At fifth grade there is a state-level, high-stakes assessment. These teachers of English as a Second Language (ESL) have noticed an overwhelmingly low confidence level among the students. As exciting as science content might be with the incorporation of hands-on and inquiry-based learning at the upper elementary level, the students seem to not show interest in classroom science activities.

Many bilingual students are expected to transition to an English-only classroom by the end of second grade. After third grade there is an intense program of intervention

targeting primarily struggling ELL's. This program is Read 180. All of my students have been identified by home language surveys and the IDEA Proficiency Test (Individuals with Disabilities Education Act - IPT) which evaluates the student's verbal language dominance in English and Spanish. Many of the students may have been born in the United States of America and have spoken only Spanish at home. Some of the students may have recently moved from another school district where less English is expected of them in kindergarten than in our district.

I believe that this lack of science knowledge and vocabulary may be addressed effectively in the primary grades. From my own experience, I believe that students in kindergarten, first and second grade are very interested in the natural world. It seems that they have not yet developed qualms about taking risks such as guessing; only to later find out they were mistaken. These naïve conceptions are normal for younger students. I believe if primary teachers can expose students to inquiry-based learning with ample hands-on activities, the students will have a better command of the non-science related English necessary to understand and communicate their learning in regards to the science topics studied. Vocabulary built through experience might help these students have a better attitude towards science and boost their self-confidence. Through cooperative groups, hands-on activities and inquiry-based learning, students will build the English language they may be lacking to be able to effectively communicate with each other.

My students come to first grade having never been to the science museum or to the zoo. Students need informal experiences to build language. I have come to notice over my nineteen years of teaching that many of these students have been to visit their cousins in Mexico and played around outside at their family's ranch, but have never been to the beach which is less than 100 km away. Many parents have two and three jobs. A relative

or neighbor may need to care for them after school or late into the evening. Families do not have a common meal together. This is where home-language vocabulary would be used in an informal situation. Because of economic reasons and time or other factors of which I am not aware, parents do not take the chance to expose their children to informal science opportunities.

Our district is in a suburban setting near a major Southern US city. Museums and outdoor experiences such as the zoo are not within our reach for a field trip. This is due to the time that it would take to get to the museums during high traffic and back in time for the high schools' and middle schools' afternoon bus schedules. We have a field trip each year to the district's Science Resource Center. This is often the only informal exposure our students have with science.

My students are first graders and the majority of my instruction is concentrated on mathematics. There is very little science instruction allotted in our curriculum. I have science two to three times per week during the twenty minutes before lunch or the last twenty minutes of the school day. For the morning students, their stomachs are grumbling, waiting for lunch. For the afternoon class, the students are almost getting ready to go home.

Throughout my years of service as an educator, I have elected to monitor and support my former students as they progress from grade level to grade level by forming professional cadres with my colleagues. It concerns me that some of my former students are struggling in science and are exhibiting a negative change to their attitudes towards science.

For my action research project, I examined how inquiry-based instruction affected my English Language Learners' attitudes towards science. I have been teaching English

Language Learners for nineteen years and feel blessed to have the opportunity to serve this population of students. This is my twelfth year teaching first grade.

My research team included my principal, assistant principal, two of my grade-level colleagues, five math/science vertical team members who serve the bilingual population as well as ELL's. I also have a trusted friend to help me with accountability and timelines. My editor is a math/science teacher who just finished her degree in administration. Even though I am fluent in Spanish, I enlisted the help of a translator who is also a bilingual teacher at my campus. One more member of my research team is a Kindergarten teacher, my best friend, trusted colleague, and wife of twenty-two years. Robyn Klein, adjunct Professor of Montana State University, as well as my assistant principal will serve as my readers at the MSSE Capstone Symposium in July 2013.

Focus Questions

My main research question is: What effect will inquiry-based learning have on my English Language Learners? The first sub-question is: How does inquiry-based learning affect students' attitudes towards science? The second sub-question would be: How does inquiry-based learning affect students' understanding of science-related vocabulary? Finally: How does expecting an inquiry-based approach from my students impact me as a teacher?

In order to address these questions I needed to find out what studies had been done and professional papers had been written from which I could take guidance in my research.

CONCEPTUAL FRAMEWORK

At first, I believe it is appropriate to take a look at certain terminology with which one might need to be acquainted in order to understand this research project.

Terminology

English Language Learners: Abbreviated ELL's, are students whose first language is other than English. These students are simultaneously learning content, such as math, science or social studies as well as learning to listen, speak, read, write and think in English.

English as a Second Language: A program where specially-trained teachers incorporate strategies and techniques specifically to encourage English language acquisition. Often these certified teachers teach other subjects than Reading and Writing of English.

Inquiry-Based Learning: Strategies where the teacher presents content in open-ended format where the students can determine what direction they wish to take to attain the knowledge necessary to be proficient in the content. Students ask their own personally pertinent questions and develop their own investigations. Students work in groups where they must cooperate, share ideas, build vocabulary and together decide how they wish to present their findings to their fellow classmates.

Literature Review

The first significant theme of my literature review is that English Language Learners, also referred to as culturally and linguistically diverse students, will perform better using inquiry-based learning as compared to other forms of science instruction (Lee, Buxton, Lewis, LeRoy, 2006). Students will not benefit from simply listening to lecture. These students need to not only decipher science vocabulary, but comprehend

the English language presented by the teacher. Her point is that the students we teach are diverse and have different meanings for science *scientia* (knowledge). We in the Western world sometimes might have a skewed view of what others might refer to as science. The teacher must, in turn, be open-minded. This reminds me of a graduate student friend who works on an American Indian reservation where she has to be very open-minded about accepting science as truth. Science is a body of knowledge that is commonly accepted and rejected, proven and refuted. How many times through history has a common “scientific truth” been disproven e.g. geo-centric universe, down-grading of Pluto to a dwarf planet etc.?

According to Lee and Buxton (in press) Western “modern” science may not accept a universalism, but have an approach of assimilation that discounts other ways of thinking. I need to accept that a student’s culture may accept something as “truth” which may be something very foreign to me. Turning that around, our culturally and linguistically diverse students may be astounded with what “we” in science are expecting them to just learn and accept as the only way of thinking.

It also seems that many teachers are extensively trained in second-language development and may even be certified in English as a Second Language (ESL), yet very few teachers are adequately trained in science instruction strategies for the second-language learner (Lewis, Maerten-Rivera, Adamsen & Lee, 2011). From my teacher perception interviews from a previous assignment for a graduate level class, teachers offer hands-on activities as the bridge to get students to achieve a greater understanding of the content. Quoting Hart & Lee (2003, p.477), “Hands-on activities are less dependent on formal mastery of the language of instruction and thus, reduce the linguistic burden on ELL’s.”

From Lee, Mearten-Rivera, Penfield, LeRoy and Secada (2008) general literacy development must be fostered along with science content. Students should work collaboratively so as to capitalize on the students varied abilities in English. It might be that the student who comprehends the material may not be the student with the highest level of English ability. Presenting the material in various modalities may help those struggling students. Academically struggling students, according to Lee et al (2006) are confronted with the usual demands of science learning via a vehicle of a yet un-mastered language. Students lacking required English language ability encounter further and deeper difficulties in science curriculum. Once again hands-on instruction is considered the key to bridging this gap.

It is likely that some administrators and science teachers have heard of and are interested in inquiry-based instruction. We are also in an era that emphasizes high-stakes testing. While each of the two has its own merit, it seems insurmountable to simultaneously emphasize testable knowledge as well as expect teachers to change their teaching approach (Pyle, 2008). Many teachers faced with the task of preparing students for the high-stakes test must limit the depth and complexity of their questions because it may be “safe” to expect knowledge and comprehension level questions. Learning is not merely listening to the teacher. Students must have their own independent construction of knowledge (Vygotsky, 1978).

Another one of the big themes of my Action Research Project is that I worked with culturally and linguistically diverse students. I explored ways to incorporate informal second-language development. I have attended countless professional development workshops where scaffolding of language has been emphasized. Teachers need to provide support through graphic organizers such as Venn Diagrams, drawings of

the experimental set-up and data tables (Lee et al, 2008). Students who are engaged in group activities might lose their inhibitions because the teacher is not always directly observing them, thus lowering the affective filter. Teachers at my campus can draw on science content trade books at varied reading levels.

It also seems that many teachers are extensively trained in second-language development and may even be certified in English as a Second Language (ESL), yet very few teachers are adequately trained in science instruction strategies for the second-language learner (Lewis et al, 2011). From my teacher perception interviews, teachers offer hands-on activities as the bridge to get students to achieve a greater understanding of the content. Lewis et al, suggest that hands-on activities should promote students' communication of their understanding. There should be a variety of formats such as gestural, oral, graphic and textual.

Okhee Lee, Professor at the University of Miami at Coral Gables, Florida has written many articles regarding teaching science to such diverse students. She encourages teachers to be open-minded when working with these students. ELL students are learning a new language and a new culture along with having the same expectation of being able to perform on state-level high-stakes assessments in all content areas. Content-area instruction has typically been separate from English as a Second Language programs. According to Lee, academic language is an essential element of language development. She goes on to say that ELL students will never reach acceptable levels of language proficiency without receiving grade-level appropriate content-area instruction. Though many districts may have adopted some very scripted literacy programs that are highly teacher-centered, English Language Learners can benefit more from meaningful interactions with the content in relationship rich environment (Guccione, 2011).

The third main theme of my research was inquiry-based learning. Inquiry does not simply mean to have lessons that are “hands-on”. When referring to “hands-on”, here are some non-examples: students have their hands on a textbook; students have their hands on a note book and pencil for copying something I wrote on the board, students have their hands on a worksheet of terms that they have to look up in the glossary and memorize. Hands-on (notice the hyphen) would refer to touching something real and figuring things out about it. This may spawn their curiosity and send them off to find answers. Hands-on may mean they will build a structure and see if it will stand and try it again to see if they can make improvements. Inquiry promotes critical thinking (Llewellyn, 2007).

Our district believes in departmentalizing the elementary. The students’ day is clearly divided in two parts. Seldom does the language arts team plan with the math and science team. According to Erik and Tatarchuk (2011) students should read about and build language that allows the students to be able to talk about what they are learning. Then students should get outside where they can move around and not be so worried about disturbing the other classes while they explore and investigate. Students should have writing prompts to think about while they are investigating so they can be conversing and practicing what they might write about later in the classroom.

Personally I am interested in the environment and want to spark students’ interest as well. I wish that we could give these students an opportunity to get outside and learn something while exploring. In an article basically in support of environmentalist agendas, I discovered that students all over the world are getting outdoors to have some fun while learning. Faněovičová & Prokop (2011) try to show how environmental efforts to protect trees can be shored up by teaching students about trees while outdoors during elementary

years. This study was conducted with students in Slovakia. In their study, they used surveys of student' knowledge and attitudes about science and plants specifically.

With the demands of "No Child Left Behind" to ensure learning for all children, no matter their socioeconomic status and the National Research Council's (1996 and 2000) call for national standards which focus on inquiry, I believe there is more than adequate literature to support inquiry-based learning for ELL's.

METHODOLOGY

The research methodology for this project received an exemption by Montana State University's Institutional Review Board (IRB) and compliance for working with human subjects was maintained. A copy of the IRB Exemption as well as parent and teacher consent forms can be found in Appendix A. After receiving district approval and granted an exemption by Montana State University IRB, I distributed the parent consent forms. I only sent the forms once and did not contact any of the parents who did not return the consent forms. I intended to include all of my students from both classes. Twenty parents out of twenty students from the morning class returned the parent consent form. One student moved half way during the treatment phase. This student's data was not considered. That left nineteen students for the morning class.

Only ten parents out of nineteen students from the afternoon class returned the parent consent form. Five students returned the form unsigned, requesting that their child's data not be considered. I respected their choice and did not include their data in my research. One of these five students moved away during the treatment phase. Four parents did not return the parent consent forms. There were two new students who arrived after the treatment phase began. Participation for my research project from the afternoon class was only ten students. Having such a small population for this class made it

interesting when one or two students were absent for one of the lessons from which I took data. Data from a population of twenty would seem more trustworthy than a population of ten. If there were any students missing from the afternoon group this would of course make the population smaller and potentially less significant.

I created a spreadsheet showing the students' codes, pseudonyms, December's district math benchmark rank and their Middle of the Year Independent Reading Level (IRL) using Fountas and Pinnell's Guided Reading (1997). The demographic information for the morning class can be found as Appendix B. Population being 19 students, the mean math rank for the morning class was a tenth out of nineteen (53rd percentile). The mean middle-of-year Independent Reading Level for the morning class was a level G. The mode was a level H and the median was a level G. The standard deviation was 1.7 reading levels. The lowest readers in the morning class were on a level D.

The demographic information for the afternoon class is presented as Appendix C. The mean rank for the afternoon class math scores was eighth out of nineteen (42nd percentile). This data does not consider the ranks for the students not participating in the research. The students who did not return the forms and those students whose parents requested that they not participate were actually among the lowest performing students. This data was not included in this research presentation. The mean middle-of-year Independent Reading Level for the afternoon class was a level F. The mode was a level D and the median was a level E/F. The standard deviation was 3.33 reading levels. The lowest reader from the afternoon class was actually a non-reader (a level lower than A).

The afternoon class had a lower average math rank, lower average reading levels, lower return of parent consent forms. These students' academic time is split up by physical education or fine arts. These students have to try to give their academic best the

last forty-five minutes of the day when the kindergarten students have returned from their P.E. of fine arts. We have open concept in our school district, meaning no walls between the classrooms. The academic areas are typically very loud. It is very difficult for the afternoon students to stay on task due to these numerous factors. Seeing that this afternoon class had so many challenges, I wanted to see how I could reach them by creating an engaging environment that might affect their attitudes towards science.

I will discuss five of the data sources used for my research project. I will use the information from these five sources of data to answer my sub-questions. My research questions are as follows: What effect will inquiry-based learning have on my English Language Learners? Sub-question one is: How does inquiry-based learning affect students' attitudes toward science content? Sub-question two is: How does inquiry-based learning affect students' vocabulary? Sub-question 3: How does expecting inquiry from my students impact me as a teacher? Please, see the triangulation rubric below.

Table 1
Triangulation of Data Sources

	Literature Review	Attitudes Survey pre-treatment	Attitudes Survey post-treatment	Student Interviews	Vocabulary assignments	Student Exit Tickets
How does inquiry-based learning affect students' attitudes toward science content?	X	X	X	X	X	X
How does inquiry-based learning affect students' vocabulary?	X	X	X	X	X	X
How does expecting inquiry from my students impact me as a teacher?	X			X	X	

I conducted the student surveys before beginning the treatment phase of my research. This two page survey can be found as Appendix D. I included every student whose parents returned the consent forms in order to obtain a potentially broader range of responses. I hoped to gain a general understanding of my students' attitudes regarding science. The student data from the survey served to guide me in the topics on which I focused during the treatment stage.

After the student surveys, I conducted individual interviews with eight students, four from the morning class and four from the afternoon class. I use a stratified random sampling method to select students in order to obtain a wide variety of opinions, achievement levels, and interests. In order to accomplish this task, I randomly selected students who fell into one of the quartiles for math class. The interview questions can be found in Appendix E. The interviews allowed me to probe deeper into my students'

thinking when compared with the closed-ended Likert surveys mentioned above. I conducted these student interviews before implementing treatment to obtain a baseline of students' attitudes towards science.

I conducted interviews with five of my colleagues regarding students' attitudes towards science. I used this information I gained from this process to help me decide what topics and methods I would use for my lessons. A common theme that I observed was that students need more opportunities to read science literature. Four out of five of the teachers mentioned that the students might be interested in the content but lack confidence in their abilities. Students who come upon an unfamiliar word tend to stop there and do not attempt to move on.

All five of the teachers mentioned that students seem to have no working knowledge of common English words. It is not only science terminology that stumps them, simply common English. I was not allowed to field test my lessons or other instruments since I only had permission to work with my own two groups of students. I did, however, meet with my grade-level colleagues to discuss whether they thought the instruments seemed fair and unbiased. In my reading of the literature, I had found other researchers who had used similar instruments. I, of course, needed to modify them for my students considering age and English language ability. Other researchers had used a Likert scale with their test subjects. My Likert had only three possible answers: positive, neutral and negative. I made it easy for my students by using the three emoticons. These instruments were reviewed by my professor, administrator as well as district and the university IRB.

After each lesson (non-treatment or treatment) the students were handed a slip of paper which showed three faces similar to the ones found on the students surveys found

in Appendix F. The students were asked to respond by circling the face that best described their emotions after the lesson. If they really enjoyed the lesson or they thought it was “awesome” they would circle the “happy face”. If the students wished to express that they were bored or that it was not very interesting they would circle the “sad face”. If they thought that the lesson was just “okay” then they would circle the “dead-pan face”. As a stipulation by the district, it was required that both groups of students have equal access to the inquiry-based instruction. It was imperative that neither group of students would be denied this new teaching strategy. For this reason, I devised the following treatment plan. For lesson one, the morning class received the non-treatment lesson and the afternoon class received the treatment lesson. Then later in the week I gave the non-treatment lesson to the afternoon class and the treatment lesson to the morning class. This went on for eight paired lessons, lasting about five weeks. The rubrics, content-knowledge assessment or vocabulary assignment for these eight paired lesson can be found as Appendices F through T.

Treatment

I will now move into describing the non-treatment/treatment phase of my Capstone Project. I prepared eight paired lessons. Each pair of lessons addressed the same subject matter but the material was presented differently. For the non-treatment lesson, I, the teacher, was at the center of the lesson giving the students knowledge. Students did not have choices. I gave the students material to study and discuss then they were asked to complete an assignment based on the knowledge and vocabulary. As the treatment lesson, I presented a student-centered, inquiry-based lesson during which the students often worked together. They were asked to decide the direction they would take

and what they wanted to study on the given topic. Books were available for the students to browse through. Assignments were more open-ended.

I will now describe lesson by lesson each non-treatment/treatment pair of lessons. Lessons 1NT and 1T were focused on the topic of the life cycle of a frog and general vocabulary that the students would need in order to adequately discuss the topic. For lesson 1NT (teacher-centered, non-treatment lesson with the morning group), I presented a lecture about the life cycle of a frog and drew a diagram on the white board at the front of the class. I had the students listen to me as I gave them information about the frog life cycle and then return to their tables. The students were asked to draw what they had learned on a sheet of paper including vocabulary words that they believed were important for understanding the phenomenon. I graded their papers that evening using the rubric I had created (Appendix F).

On the other hand, for lesson 1T (inquiry-based, student-centered, treatment lesson with the afternoon group), I gave the students the rubric up front (Appendix G – note it is the same as the non-treatment rubric). I explained that the rubric showed them what they needed to know after the lesson. I chose the topic, yet the students decided what direction they should take to obtain the information. Students were given books to read on the topic of frogs. They watched a few videos about frogs. They went online to a few child-friendly websites. Students had discussions amongst themselves regarding the frog's life cycle. Then the students were asked to draw on a sheet of paper the life cycle of a frog and include the vocabulary listed on the rubric. I point out that the treatment lessons are more student-centered.

For Lessons 2NT and 2T we continued with the topic of frogs. For lessons 2NT (teacher-centered non-treatment lesson with the afternoon group) I gave the students a list

of facts that I believed they should know about frogs (Appendix H). Typically a list like this might come from a prescribed district or state curriculum; however, this time I created it. We took a few minutes to discuss these facts and clarify any unfamiliar vocabulary. Here, I must remind the reader that my students are English Language Learners and the majority of them are classified as “beginners”. New vocabulary for ELL’s is difficult to internalize without experiences. The students were sent to their seats to draw and/or write about the facts from the list they had received.

The inquiry-based Lesson 2T (inquiry-based, student-centered, treatment lesson with the morning group) began with handing the students a KWL chart (Appendix I). This is a type of graphic organizer where the students first list what they Know about the topic of study, and then they make a list of things they Want to find out. After the students have had time to research their topic, they list what they had Learned from their research. Just a note, the students had not used this kind of organizer before. The students were given time to work together and decide what they wanted to work on. They chose their own partners and monitored each other’s progress. The students filled out their KWL chart and handed it in for me to grade.

For Lessons 3NT and 3T the topic switched to the study of weather. Similarly to lesson 2NT I created a list of facts (Appendix J) that I believed the students should know for lesson 3NT (teacher-centered non-treatment lesson with the morning group). I discussed the facts with the students, illustrating on the white board concepts that may have been difficult for second language learners. Time was given for the students to discuss the facts and ask questions. Students were sent back to their tables to write and draw about what they learned during the lesson. Also included in Appendix M is the rubric with which I scored the student’s responses. For lesson 3T (inquiry-based, student-

centered, treatment lesson with the afternoon group) we began by reading books about weather, we watched a video of a tornado. Students were engaged in discussion about many aspects of weather. I took the students outside to work on a skit in order to present a weather-related vocabulary word for the other students to guess about what they were trying to portray. When the students came back inside, they were given an organizer (Appendix K) on which they could record weather related vocabulary words.

Considering that both hummingbirds and ducks were topics from the student pre-treatment survey, I decided to have Lessons 4NT and 4T address the topic of birds. Lesson 4NT (teacher-centered non-treatment lesson with the afternoon group) culminated with a bird knowledge test (Appendix L). First we spent ten to fifteen minutes discussing important information that the students should know about birds. I showed the students my binoculars and field guides for bird identification. I showed the students some websites where we could learn about different kinds of birds. Then the students were given the bird knowledge test. I also asked the students to take a few minutes to write or draw about something else that they might know about birds. For Lesson 4T (inquiry-based, student-centered, treatment lesson with the morning group) the students were given two empty toilet paper rolls with which to pretend they were using binoculars. We then went outside with their “binoculars”, journals and pencils. I brought along my bird identification field guides and my forty power magnification binoculars. We walked around the playground looking for birds. Students asked each other, “What kind of bird is that?” They came to ask me. I turned the question back around towards the students to see if anyone knew what that kind of bird was called. Students sat down and drew in their notebooks. When we came back inside, I gave the students fifteen minutes to read books

I had checked out from the library. Then I gave the students the same bird knowledge test (Appendix M) that was used with the other group.

The school where I teach is about 100 kilometers from the beach and I would imagine that most of the students would be interested in ocean animals. Lessons 5NT and 5T had a theme of ocean animals and classification of animals as to whether they were fish, mammals, birds etc. Lesson 5NT (teacher-centered non-treatment lesson with the morning group) began with a discussion of different types of animals that might be found in the ocean. As the students offered suggestions I created an organizer on the white board. I put mammals like dolphins and walruses together, sharks and clownfish together etc. After fifteen minutes of eliciting student response, the students were sent to their table with a graphic organizer/word puzzle (Appendix N). For Lesson 5T (inquiry-based, student-centered, treatment lesson with the afternoon group) the students were given books to browse on the topic of ocean animals. Students were allowed to work together and study about the ones that were interesting to them. Students could choose with whom they wished to work. Students drew pictures and wrote facts about the ocean animals that interested them. After twenty minutes the students came together to share with their friends what they learned. As an assessment, I gave them an assignment similar to Lesson 5NT, only the classification boxes were empty (Appendix O). The students wrote the names of the animals they believed fit the category descriptions. I would like to interject here that inquiry-based learning can be teacher-led or student-centered. Working with young learners, I may need to conduct much of the inquiry-based learning as the students are being exposed to inquiry-based learning. According to Llewellyn, the students need a gradual release into inquiry-based learning. In my five weeks of data collection, the students were not yet completely comfortable with inquiry-based learning.

One observation I would like to iterate here is that many of these suburban students go home after school and never go outside exploring their environs. For Lesson 6NT and 6T I took the students outside to explore the school playground. Lesson 6NT (teacher-centered non-treatment lesson with the afternoon group) began with a discussion of appropriate behaviors that were expected in anticipation of going outside. I noted to the students that it was late winter in the Gulf Coast of Texas and that it might already look like spring. I explained what we would be looking for when we got outside. We walked around together as a class from place to place as I deemed pertinent. After fifteen minutes, we came inside to fill out a response form (Appendix P). The students had a word bank to choose from in order to fill in the blanks to make meaningful sentences about our outdoor exploration.

Similarly, Lesson 6T (inquiry-based, student-centered, treatment lesson with the morning class) began with a discussion of expected behaviors when going outside for and exploration. This time, though I asked the students to discuss amongst themselves what they believed were important things to consider. The students gathered their notebooks and pencils and we all went outside. The students paired with whom they wished and wandered from place to place observing leaves and flowers and watching a “fire ant” mound that had been disturbed. Students sat down and drew the shapes of the leaves and sketched birds that they saw around the playground. When the students came in, they were given a response sheet (Appendix P) that, I should note, has more open-ended questions. This allowed for varied responses.

I had noticed that the topic with the lowest positive response on the pre-treatment student surveys was earthworms. As the last two paired lessons for my Capstone Project I chose to focus on earthworms. Lessons 7NT and 7T were in the school’s science

laboratory. I must remind the reader that my students are in first grade and we do not really have formal science instruction in this grade. This was the first time that my students had been to the science lab and no other first grade class has used the laboratory this school year. It is generally reserved for third and fourth grade classes.

For Lesson 7NT (teacher-centered non-treatment lesson with the morning group) I led the discussion with the students about what appropriate laboratory behavior should be. The students needed to write into their notebooks the four safety reminders that I, the teacher, created. When we arrived at the lab, the students followed the procedures that I had prescribed. The students progressed step by step through the lab exploration. Students made observations and recorded them on the lab sheet (Appendix Q). Lesson 7T (inquiry-based, student-centered, treatment lesson with the afternoon class) was essentially the same lab experience, however the students were asked to form a hypothesis of “what might happen if they...?”

We began the lesson with a discussion regarding the safety expectations. I had not written my own expectations on their work page (Appendix R). The students had a difficult time filling out their lab work page as they were very involved in their investigation.

Lesson 8NT and 8T were a second lesson on the Earthworm. The focus of the lessons was the anatomy and needs of an earthworm. For Lesson 8NT (teacher-centered non-treatment lesson with the afternoon class) I led the discussion leading the students to a basic understanding to allow them to answer the seven content questions about the earthworm. I was looking for the students to incorporate the vocabulary we had been using in class. I had the students work on answering the seven questions and provide a diagram of the anatomy of a worm (Appendix S). In contrast, for Lesson 8T (inquiry-

based, student-centered, treatment lesson with the morning group) I allowed the students to see the assessment (Appendix T) at the very beginning and work together to find the answers. Students could work with whomever they pleased.

I had available to them on the interactive whiteboard a website which took the students through the anatomy and functions of the parts of the earthworm. Even though this website's reading level was considerably higher than my first grade students, they seemed to enjoy trying to match the labels with the pictures. The students worked on their assignment through the time provided. For the morning group, we spent twenty to thirty minutes before lunch. For the afternoon group we took twenty to thirty minutes during the last part of the day. Since the treatment lessons often required time for the students do research, we needed to use two thirty minutes periods.

After all eight paired lessons were finished; the students took the post-treatment student survey (same as Appendix D). At this point I met with my grade-level colleagues to discuss the students' papers. We sat down with each pair of lessons and looked at the assignments from the same eight students chosen for the student interviews. They noticed that it seemed like some of the treatment lessons were more difficult due to a new kind of graphic organizer. They believed that the lessons were fair and appropriate for end of first grade or second grade. Considering the analysis below, one needs to remember that treatment lessons may be more difficult as determined by a group for grade-level colleagues.

DATA AND ANALYSIS

The data and analysis section of this paper consists of four main sections. The first section will begin with the pre-treatment and post-treatment student surveys measuring attitudes towards science related topics. The second section will present the data from the student interviews. The third section will be a presentation and analysis of the data from the students' content/vocabulary assignments. Finally I will present the data for students' attitudes with regards to the non-treatment and treatment lessons.

Pre-treatment Student Surveys:

Initially the purpose for the student survey was to see to what kind of informal science the students had been exposed. I also gave the same instrument as a post-treatment survey. I wanted to see if exposing the students to science might influence their attitudes towards the items addressed in the survey. The student survey may be found as Appendix D. I will first present the data for my morning class, then the afternoon class. The students were asked to choose from a smiling face, dead-pan face and frowning face. Choosing a smiling face would indicate good feelings toward the subject in the picture. This could be interpreted as being fun or interesting or possibly having had previous good experiences with the subject of the picture. A frowning face would indicate that the student has a generally negative emotion attached towards the subject of the picture. This might mean it is gross, scary, boring or possibly they had had an unpleasant prior experience with the subject of the picture.

For the morning class greater than 66.66% of the students gave a positive response for dinosaur skeletons at a museum, tent camping, flowers, raccoons, fishing, hummingbirds, fruits & vegetables at a market and ducks. That would be nine of fourteen topics with more than two-thirds of the students expressing a positive response. Were

these students with a higher average ability level given more opportunities to go to the science museum to see dinosaur skeletons or been camping with their families? Have they had experiences with fishing and wildlife? Do their parents take them to the market on the weekends? Less than a third of the students gave a positive response to frogs or earthworms.

Now I will consider the afternoon class. I need to remind the reader that only 50% of the parents returned the parent consent form. Also I must consider that this group's independent reading is one level lower using Fountas and Pinnell's Guided Reading (1997). More than two-thirds of the students from the afternoon class liked autumn leaves; tent camping, flowers, raccoons, hummingbirds, fruits and vegetables and ducks. That would be eight out of fourteen topics. I notice here the absence of "seeing the dinosaur skeleton at the science museum." Less than a third of the students in the afternoon class gave a positive response to frogs, earthworms, fishing and praying mantis. Is it significant that the morning class only had two topics on their "least favorite" list and the afternoon class had four? Could this be because the students with a lower ability have also had fewer real-life experiences with the subjects from the survey? If they are unfamiliar with something, they might have a negative emotional response to it. I also find it interesting to note that the afternoon class with a lower average reading level and math scores did not express positive emotions attached to fishing. Maybe their families have they never been fishing?

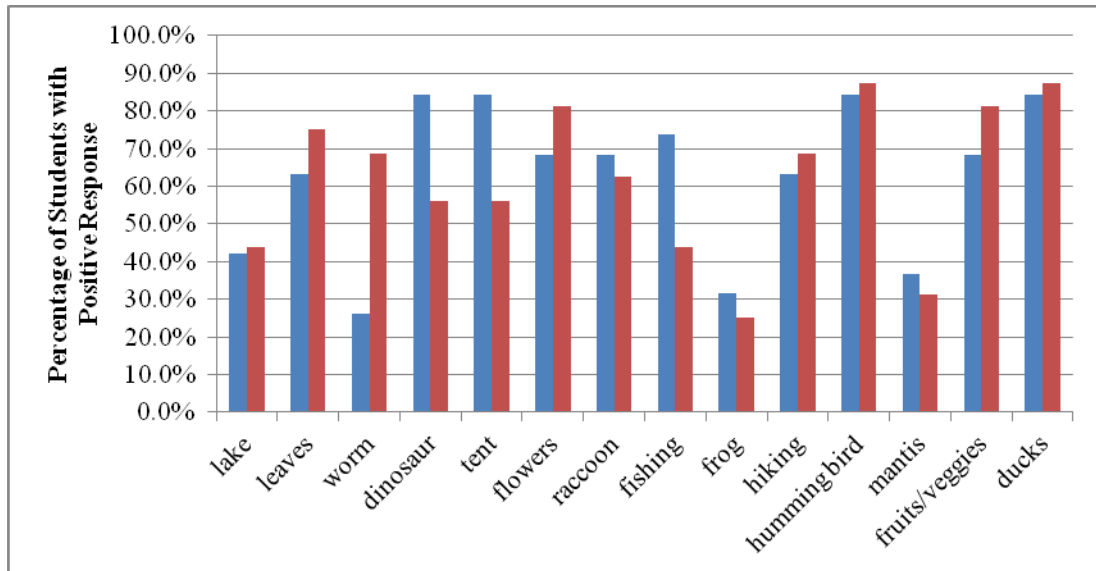


Figure 1. Comparison of morning and afternoon pre-treatment survey positive responses, (morning = blue, afternoon = red) ($N = 29$).

Both populations showed positive responses to tent camping, flowers, raccoons, hummingbirds, fruits and vegetables and ducks. I wonder why the morning class had such a dramatic difference in responses to dinosaurs and fishing. In both cases the afternoon class was lower. I wonder whether the students in the lower performing class have never been to the museum or been fishing with their families. In retrospect, it might have been a good idea to stop and ask the students who had gone fishing. I might have also asked them to write about a previous experience with fishing. Since the student survey only asked what the students' emotional response to these topics, I have no way of knowing the answer to this question. Both of the groups showed a negative attitude towards frogs and earthworms. These animals might be considered "gross" or "slimy" as compared to ducks. When I planned my eight paired lessons, I focused a couple lessons on each these two "negative attitude" topics. I would reiterate that both morning and

afternoon classes received teacher-centered, non-treatment and inquiry-based treatment lessons.

Here I will transition to the post-treatment survey data. I will begin with the morning class. Continuing with the same criteria interpreting the post-treatment survey, the morning class liked autumn leaves, earthworms, flowers hummingbirds, fruits and vegetables at the market, and ducks. Please remember that earthworms were among the two topics which received the lowest average score using the pre-treatment survey. The morning class was indifferent to going to the lake, dinosaur skeletons, tent camping, raccoons and fishing. The morning class did not prefer frogs or praying mantis.

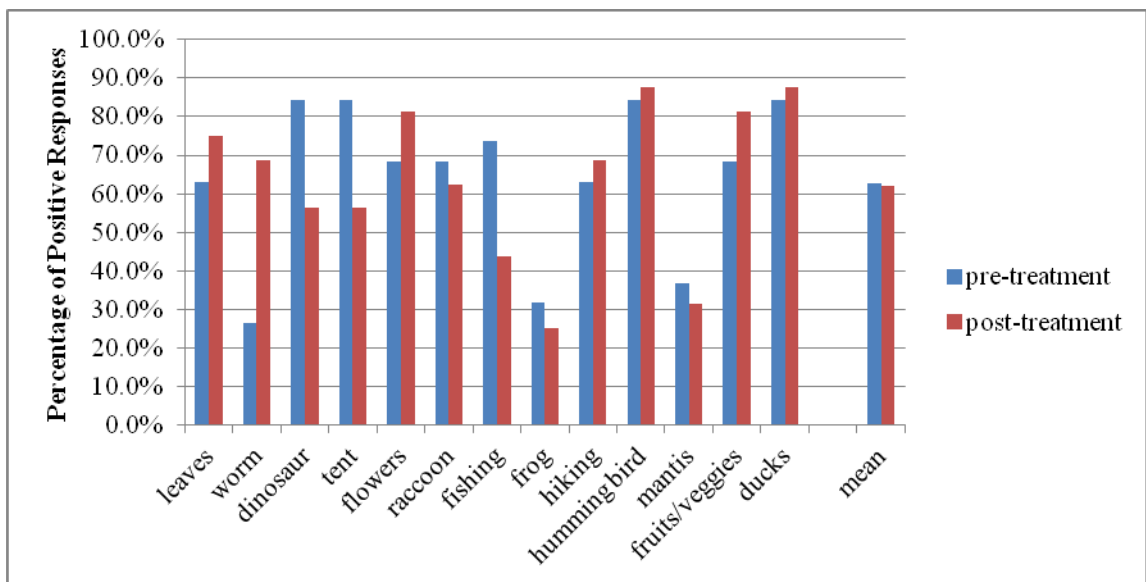


Figure 2. Morning pre-treatment vs. morning post-treatment survey positive responses, ($N = 19$).

I noticed that there seemed to be a dramatic difference in the positive responses in attitude towards earthworms. We had a lab experience with earthworms. Could this have possibly had an effect? I conducted an unpaired t-test comparing the pre-treatment versus post-treatment student surveys. The t-test revealed a p-value of 0.0001 and a t-value of

6.925 (df = 33). I am at least 95% confident that it is highly unlikely that this change is by chance. Here I will insert some of the comments from students' investigations (Lesson 7A). The students cited here are also the same ones chosen by a stratified random selection for the interviews. Please excuse the spelling errors within quotes as these are the students' comments. "The worm is moven." "Its walking and its getting big." "Its dansing." "He is dansing." "It shakes and sweshes its body." "Its moving a lot." "The worm lookn." "It is escaring a lot." "He starts geting dirty." "He starts popping." "It is going in the dirt." All three of these students chose the "happy face" response to the lesson. The mean performance score (78.33%, StDev = 7.57%, N = 3) for these selected students is consistent with the entire morning class' mean performance score (78.73%, StDev = 6.5%, N = 19). Having a good attitude toward the lesson, even if it were not a treatment lesson seems to have had a positive effect on students' attitudes towards frogs.

In contrast, the students were only exposed to the topic of frogs but they did not have any specimens in the classroom nor could the students find any on the playground. I began to wonder why some of the average responses were lower. I would like to propose that the students had become desensitized to wanting to please the teacher by responding with the "happy face. The mean positive response for pre-treatment was 62.8% and post-treatment was 62.1%. Using this student attitude survey showed no significant gains in students' attitudes when considering the survey as a whole.

I would like to share some of the students' comments regarding what they know about frogs. These statements are taken from Lesson 2T (treatment). Again, excuse the spelling, as these are the students' comments. "Frogs dont have teeth." "Frogs dont have hair." "They eat bags." "They live in raks." "Frogs and toads dond look the same." "When they are little they are tadpoles." "Frogs do not were clothes." "Toads are diffrent

from frogs.” “Amphibians mate in or near water.” “Most females lay jelly.” “Tree frogs live in areas with trees.” These comments seem more fact-based. The students did not have experience with real frogs and toads. This could be a reason why there was not the same dramatic difference between pre-treatment and post-treatment attitudes compared to the earthworm discussed above.

Now I will consider the afternoon class. Please remember that this class had a lower participation rate due to parent consent forms not being returned or parents stating that they did not want their child to participate in the research. Also these ten students’ average independent reading is one level lower than the morning population, using Fountas and Pinnell’s Guided Reading (1997).

Considering the post-treatment student surveys, the afternoon class liked tent camping, flowers, fishing, ducks and fruit and vegetables. The afternoon class was indifferent to hiking, hummingbirds, praying mantis, going to the lake, autumn leaves, and dinosaur skeletons. Here again the data shows an increase in the average positive response to the earthworm.

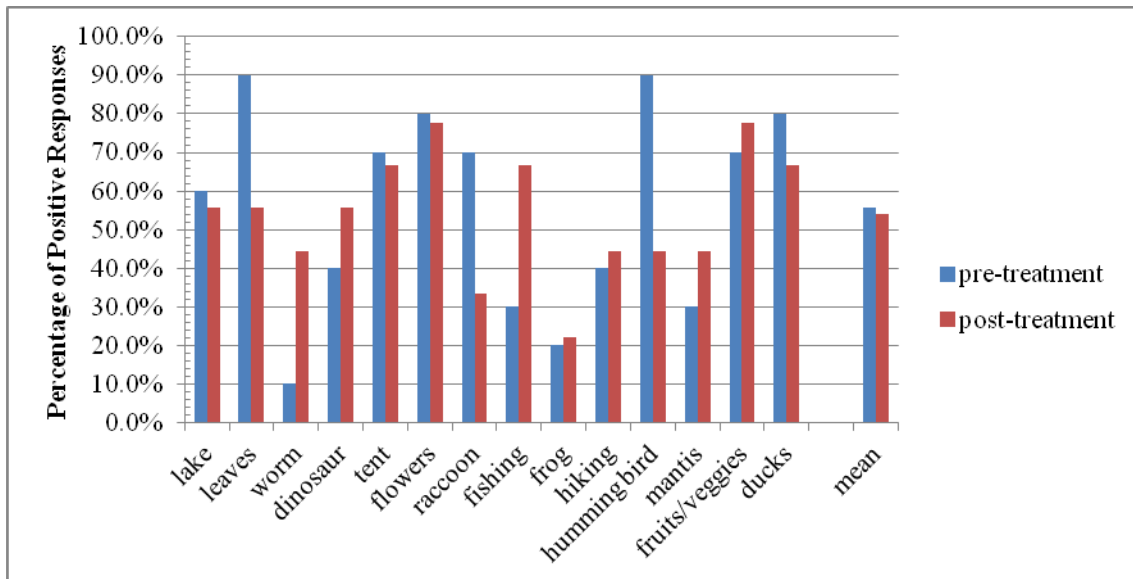


Figure 3. Afternoon pre-treatment vs. afternoon post-treatment survey positive responses, ($N = 10$).

Similar to the morning class, there seems to be a dramatic difference in the positive responses to the earthworm. I conducted an unpaired t-test comparing the two means of pre-treatment versus post-treatment. The t-test revealed a p-value of 0.004 and a t-value of 3.333 ($df = 17$). This would be considered statistically significant. I am at least 95% confident that it is highly unlikely that this change is by chance. I will again present here some of the students' comments from their worm investigation (Lesson 7T). "It (the worm) will move and dig." "He move his tale." "It will move fast." "He got slimmer." "He will slip to the plate." "It is going to get scered." "He crowle away." "It will try to escape to much." "It will daiy." "Is going to mouv." These comments seem to carry with them enthusiasm. Could this have contributed to there being a rise in the average number of students who chose the "happy face" response? It was very exciting for me to observe such a change in the students' attitudes towards the earthworm. Many of the students

seemed worried at first after I had placed the earthworm on their table. After only a few minutes, everyone was highly engaged.

Interestingly the afternoon class also had a dramatic increase in the number of students who had a positive attitude towards fishing. I conducted an unpaired t-test comparing the pre-treatment versus the post-treatment responses toward fishing. The t-test revealed a p-value of 0.002 and a t-value of 3.556 ($df = 17$). This would be considered statistically significant. . I can say with at least 95% confidence that the treatment effect cannot have occurred by chance.

For the afternoon group, the average percentage of positive responses for the pre-treatment assessment was 55.7% and for the post-treatment assessment was 54.0%. Though there may be fluctuations of percentages within the responses, literally there was no effective change in attitude towards the topics addressed in the Student Attitude Assessment. We can see that there were fluctuations in the responses between pre-treatment and post-treatment. In comparison the morning group had an overall higher positive response (62%) to topics in the Student Survey. The Box and Whisker Plot in Figure 4 shows that really there was no significant difference in the means between the two groups. The Welch's 2-Sample t-test conducted on the data from both classes, pre-treatment and post-treatment revealed a t-value of 1.358 and a p-value of 0.18 ($df = 54$). Figure 4 below shows just how similar the two sets of data were.

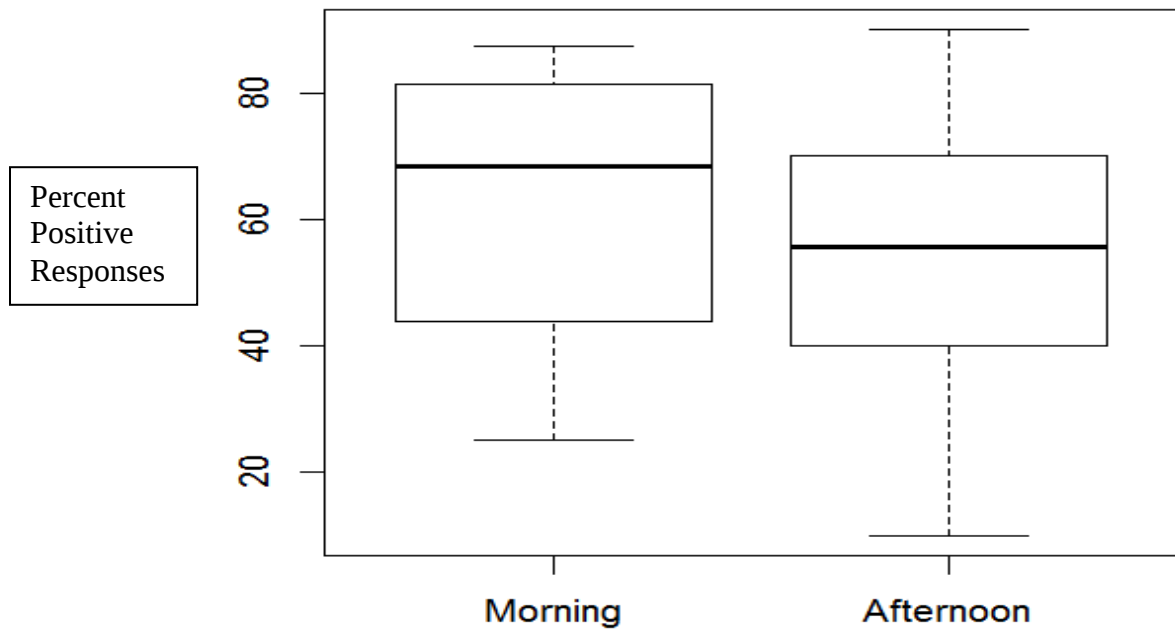


Figure 4. Box and whisker plot of morning pre-treatment and post-treatment vs. afternoon pre-treatment and post-treatment survey positive responses, ($N = 29$).

I combined the pre-treatment and post-treatment survey data and presented it in this box and whisker plot. It could be more than a coincidence, possibly some correlation that the higher attitudes towards science (previous experiences) come from students with higher reading levels and math scores. Conversely, students with informal science experiences have higher reading levels and math scores.

In the following sub-section I will present the data from the student interviews. For the interview questions, I selected what I believed to be common experiences that children might have had in their six or seven years. I must remind the reader that between 75-80% of my students receive free or reduced lunch due to a low socio-economic family situation. I chose eight students among the twenty-nine participants by conducting a

stratified random sample. I made my selection by considering the students reading levels and English language development. There were two girls and two boys from each class.

In this next section, I will discuss the data from the student interviews. The list of questions approved by university and district IRB can be found in Appendix E. First, I found it interesting that 100% of the interviewees had been to the park with the average number of visits being eight. I should mention here that there is a loose interpretation of the word “park”. On the school grounds there is a playground. In Spanish the playground is simply called a *parque* (park). There is also a park across the street from the school, next to the subdivision pool. There is, however, a park for soccer, baseball, running, jogging, riding bikes, picnics etc. about ten minutes from the school.

Eighty-three percent of the students have planted flowers, or collected leaves. The Spanish word for “collect” and the word for “gather” (meaning to sweep/clean up) are the same word, *recoger*. It could mean that the students have helped their parents clean up the yard and not specifically look at the different types of leaves that they had found. Eighty-three percent of the students responded that they had made a healthy snack. I would guess that the first grade students might understand what would be healthy and what might be considered “junk food”. Seventy-five percent of the interviewees responded that they have watched a caterpillar or have gone to the zoo. The average number of visits to the zoo was twelve. At first I was surprised by the abundance of responses to having gone to the zoo, since it is located more than a half an hour from our school. A couple of the students mentioned that there is a “little zoo” at the park previously mentioned that is located about ten minutes away. Only 25% of the students have ever taken the time to watch birds, been hunting for bugs or gone to the science museum. An interesting note is that both of the students who had been to the science

museum were boys. What I took from the interviews was a feeling that my students do not have many opportunities to interact with the natural world around them.

After each of the interviews I asked the students to think about a time when they had fun outdoors, where they were, who was with them and what they were doing. Fifty percent of the students recalled an event where both parents were with them. Twenty-five percent were only with their mom. Half of the students mentioned an experience they had at a park while swinging, using the monkey bars, playing tag or “grilling meat.” Only one student mentioned anything related to nature. She had found some caterpillars and ladybugs. Then her dad made her take them back outside. Though they have been to the park on average eight times (that they can recall), these students are six or seven years old. I would imagine that this number would be higher in a class with different demographics as far as socio-economic or home language. It would be interesting to have the opportunity to conduct these interviews with students from other classes to compare data. We can see how important informal, outside of the school setting real-life experiences are; especially for these English Language Learners.

For this next sub-section, I will discuss the average academic performance on treatment and non-treatment assessments/response sheets. After each of the eight paired lessons, the students were asked to complete an assignment. I took these assignments home for the evening and gave them a raw score reflecting exactly how many questions they had correct. If, for instance, there were fifteen items on the assignment and the highest score was only an eight, I would need to make a special consideration. I felt that the students were very interested in the assignments and highly engaged. They really only had about twenty to thirty minutes for the lesson including building vocabulary and

working on their assignment. Considering this, I calculated the mean score for the assignment as well as the standard deviation.

I will first present the data for the morning class. There is no significant difference in the means when comparing treatment vs. non-treatment. The mean academic score on the products in both the treatment and non-treatment lessons is 79%. Within the figure the use of the abbreviation of “N-T” would stand for non-treatment. For example “1 N-T” would mean the first lesson and that it was a teacher-centered non-treatment lesson. Similarly the “T” following the lesson number would indicate that the lesson in question was a treatment lesson. The “ μ ” symbol represents the mean/average.

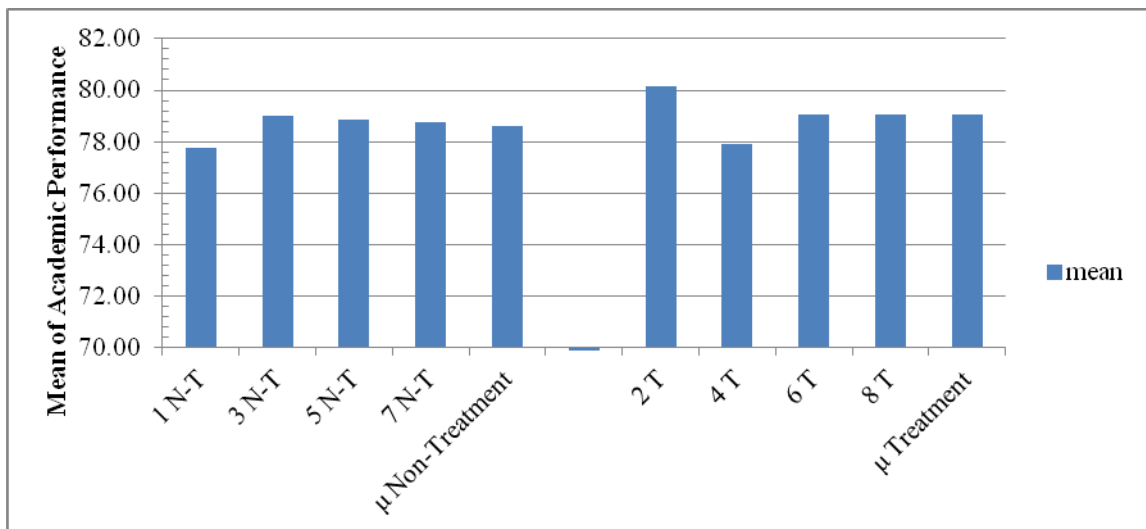


Figure 5. Comparison of the means of academic performance: non-treatment (N-T) vs. treatment (T) lessons, morning group, ($N=19$).

I will now continue with the afternoon class's academic performance on the treatment and non-treatment lessons. The mean academic score on the products in both the treatment and non-treatment lessons is 79%.

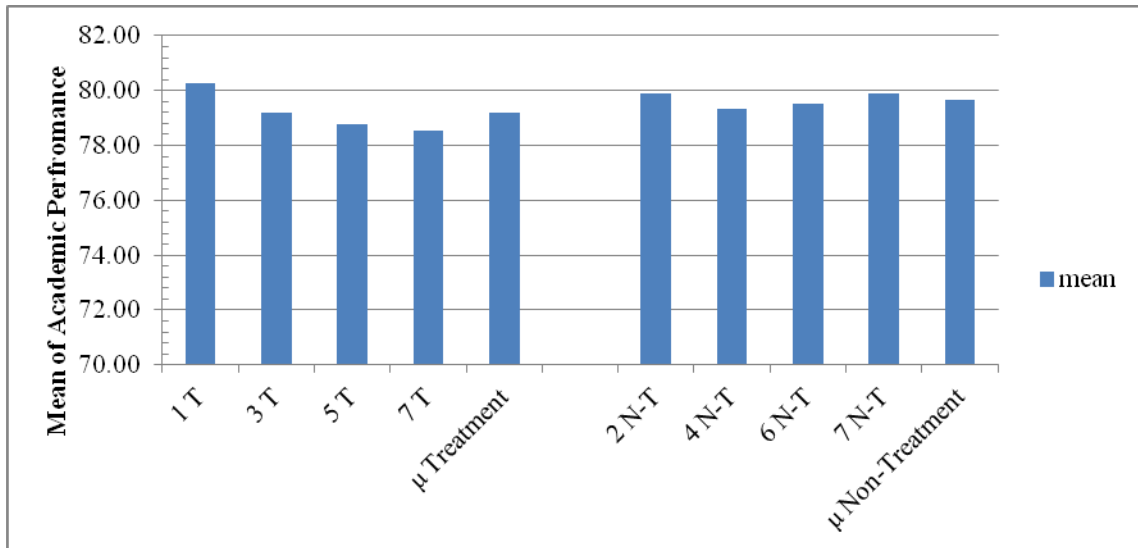


Figure 6. Comparison of the means of academic performance: non-treatment (N-T) versus treatment (T) lessons for the afternoon group, ($N=10$).

Even if I consider all treatment and non-treatment lessons, forgetting about which different population demographics, there is no significant difference in the means.

Consider Figure 7 below.

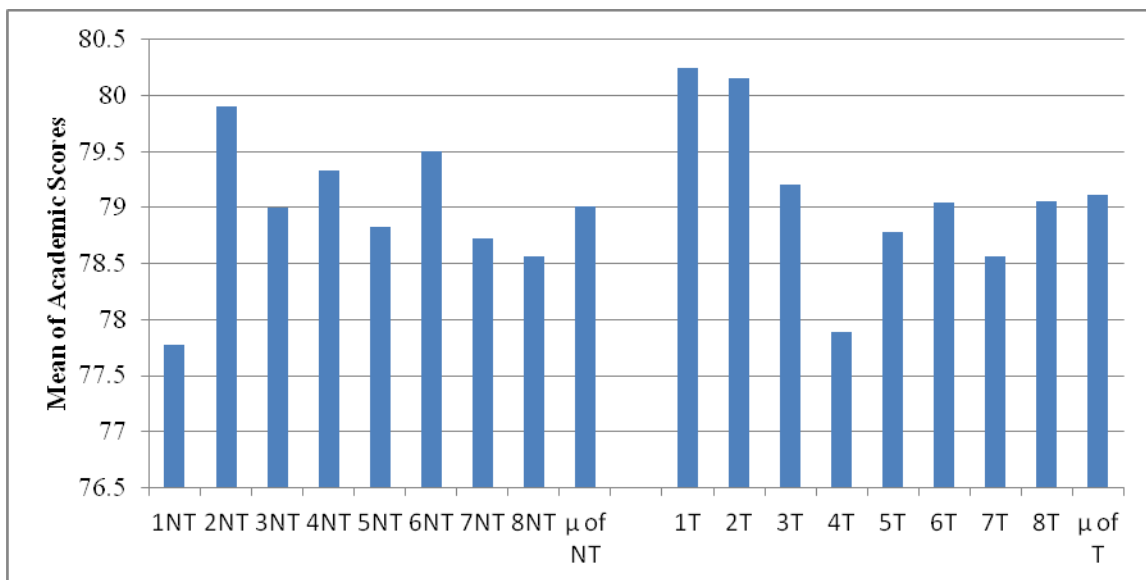


Figure 7. Comparison of the means of academic performance: non-treatment (N-T) versus treatment (T) lessons for both groups, ($N=29$).

Another way to look at this data would be a Box and Whisker plot seen below as Performing the Welch's Two Sample t-test showed a t-value of -0.459 and a p-value of 0.654 (df = 14). Below is a box and whisker plot of this data.

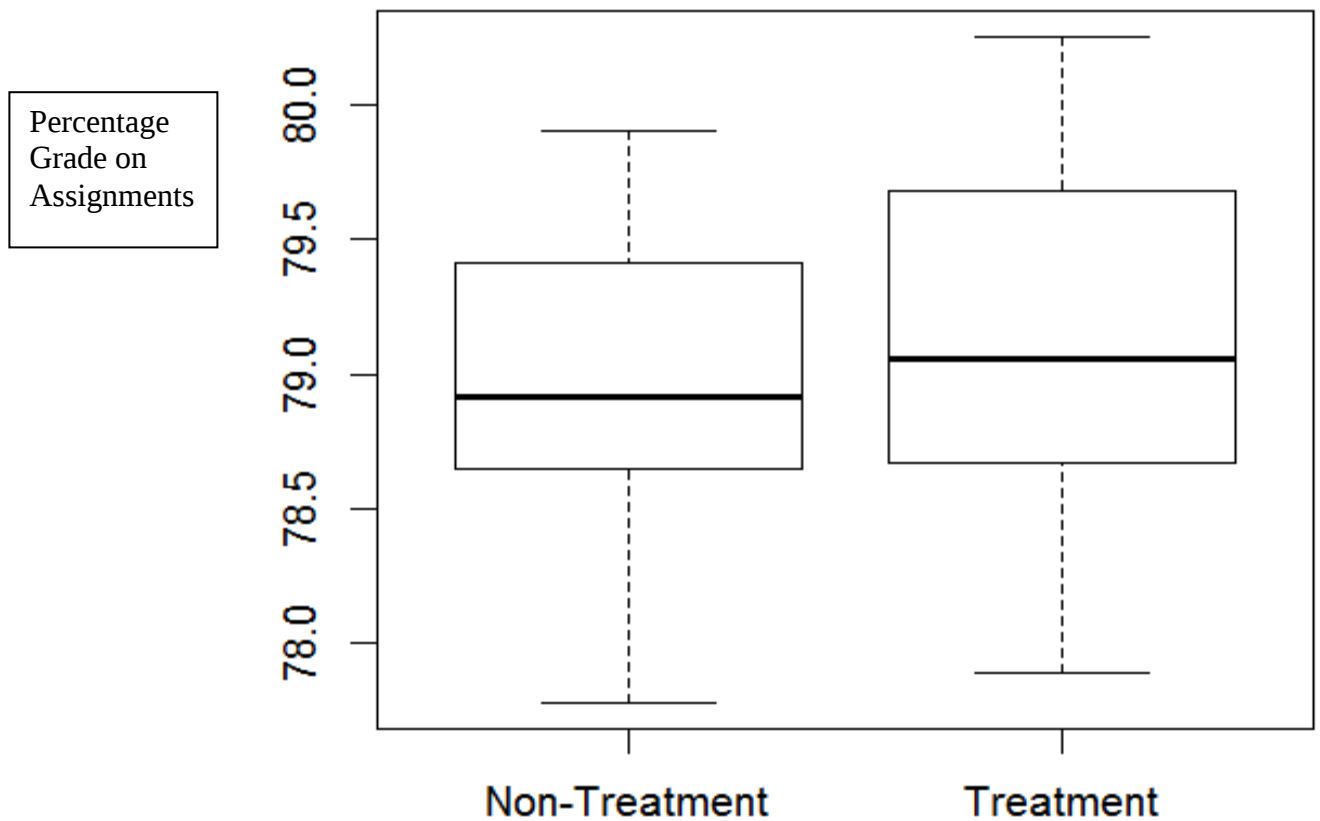


Figure 8. Box and whisker plot comparison of the means of academic performance: non-treatment (N-T) versus treatment (T) lessons for both groups, (N=29).

Since there is no significant difference in the means of the treatment and non-treatment lessons, could this show reliability of my instruments and grading practices? Simply considering quantitative data in regards to students' academic performance as

well as the method by which I grade the students' work, I cannot say that inquiry-based learning had a measurable effect on science content or vocabulary. I believe that no difference was observed because I did not use the same assessment to measure content-knowledge and vocabulary. The fact is that I had only twenty to thirty minutes to introduce the topic, allow for exploration and then have the students work on some assessable product. Real science deserves more than twenty to thirty minutes twice a week.

Now to present what I consider the "meat" of my research. I will now discuss the students' attitudes towards the treatment and non-treatment lessons. After each lesson a slip of paper, referred to as my "exit tickets" were distributed. Each had three faces like the ones on the student surveys. The students were asked to circle how they felt after each lesson. They were to consider the following statements: Was the lesson great? Amazing? Super interesting? Awesome etc.? If so, they should choose the "happy face". Was the lesson boring? Not fun? Not interesting? If so, they should choose the "frowning face". If they did not have clearly positive or negative emotions after the lesson, then they should choose the "dead-pan" face. As a definition, lesson "approval rating" would mean the percentage of students who chose the "happy face" on their exit ticket.

First I will present comparison of the morning group's attitudes towards non-treatment versus treatment lessons. I counted the number of "happy faces" and divided by the number of students who participated for that lesson to create what I labeled the approval rating for the lesson. "N-T" signifies a non-treatment lesson. Similarly the "T" would represent the treatment lesson.

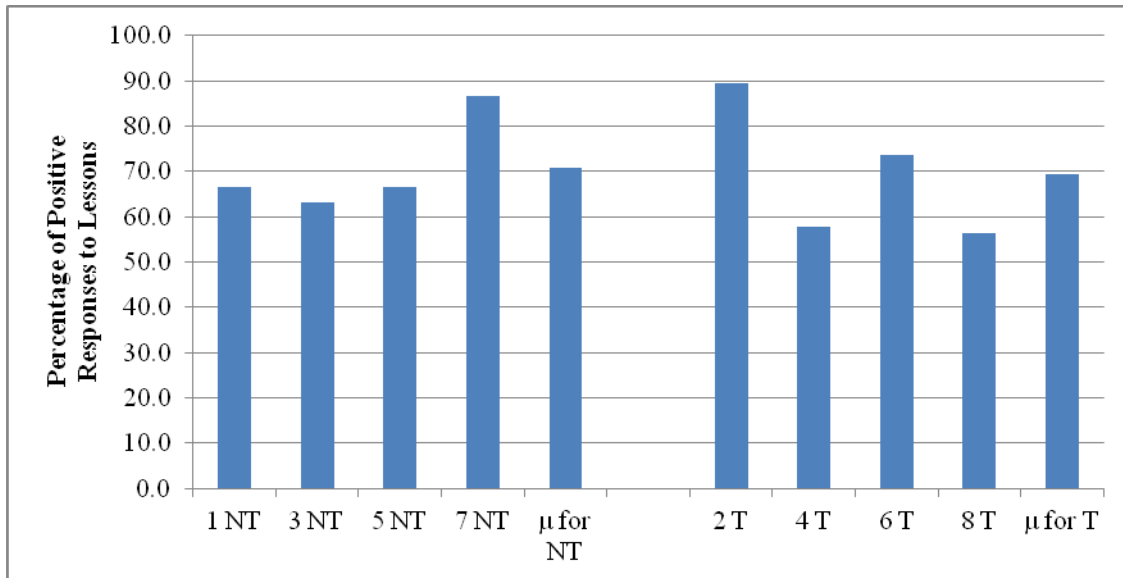


Figure 9. Comparison of the means of students' positive attitudes towards science lessons: non-treatment (N-T) versus treatment (T), morning group, ($N=19$).

I would point out here that the approval rating for lesson 7NT was 86.7%. Lesson 7NT was the earthworm lab. Even though teacher-centered and scripted, the students were very engaged and enthusiastic about being in the science lab and working with a live earthworm. The mean approval rating for the morning class's non-treatment lessons was 70.79% ($N = 19$). The mean approval rating for the treatment lessons for the morning group, however was 69.33% ($N = 19$) Lesson 2T was the KWL chart. Students worked together collecting information about frogs. Students chose their own partners and means by which they wanted to share their new knowledge with their friends. The approval rating for lesson 2T was 89.5%. I would like to note here that I imagine that the majority of these young students want to make their teacher happy by choosing the "happy face" response. This explanation is possible.

There is no significant difference in the means of the approval rating between the non-treatment (70.79%) and treatment lesson (69.33%) for the morning class. I remind the reader that the morning group had 100% participation. Also, the average reading level

(level “G”) was one level higher than the afternoon group (level “F”). The mode reading level for this group is actually higher than the mean (level “H”). I would say that the morning group is made up of above average students who are also “teacher pleasers.” I also need to point out that in first grade there is little time for science. Most of my instructional time is focused on math and especially English Language Development. A high approval rating for the science lessons could have been more due to novelty, no matter how it was presented. Seventy percent of the students basically saying that “the lessons were amazing” or “super interesting” is well above the expected frequency of 33%.

Now I will present the data from the afternoon class, comparing students’ attitudes towards treatment versus non-treatment lessons.

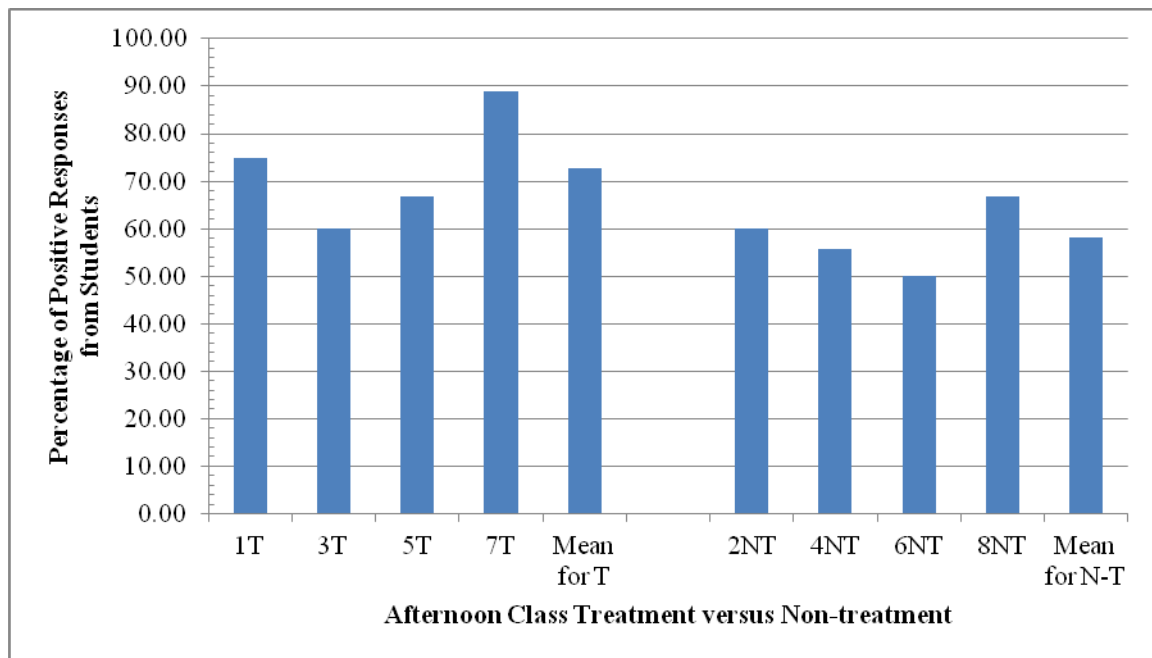


Figure 10. Comparison of the means of students’ positive attitudes towards science lessons: non-treatment (N-T) vs. treatment (T), afternoon group, (N=10).

The mean approval rating for the afternoon group's non-treatment lessons was 58.1%. We can see that the non-treatment lessons for the afternoon group received an approval rating of 60% or below three times out of four. However, Lesson 8NT was a follow-up lesson for the earthworm lab. This lesson received an approval rating of 66.7%. The students simply needed to copy notes from the white board taken from our class discussion. Even if these were non-treatment lessons and even if they were teacher-centered lessons, essentially, six out of ten students "loved" the science lesson. I reiterate the novelty of taking time for science in our curriculum.

The treatment lessons for the afternoon group' showed a higher mean approval rating than that of the non-treatment lessons. The mean for all four treatment lessons was 72.6%. The lowest approval rating was 60% for lesson 3T. For lesson 3T we went outside to act out weather vocabulary. It was very windy and everyone's papers were flying all over the place. When the students came inside, they were given a grid where they could record weather-related words. This format (Appendix M) seemed a bit foreign to them. New lesson formats might present challenges to young learners. Likely, they had never seen this kind of organizer before. The other three treatment lessons received approval ratings of 66.7% or higher. The mean approval rating for the afternoon group's treatment lessons was considerably higher, 14.5% higher. I realize that the afternoon group has an average reading level ("F") that is one level below that of the morning class ("G"). Also the mode reading level for the afternoon group is a level "D". That would be two levels below the mean reading level. This group also has a non-reader, who was absent for two of the four treatment lessons. When offered inquiry-based, student-centered lessons with a more hands-on approach, and where choice and curiosity are encouraged, the students might feel better connected to the content and their classmates. I will remind the reader

that the lessons for the afternoon class were given the last twenty to thirty minutes of the day when the students are anxiously looking forward to going home. This is also when the kindergarten students in the areas nearby have returned and are not necessarily quiet. These lower ability learners need high engagement, inquiry-based, student-centered instruction in order to raise their interest level. Even though this does not show a raise in average performance scores initially, maybe the interest comes first and the content will follow.

Next I will compare, side by side the approval ratings for each set of paired lessons.

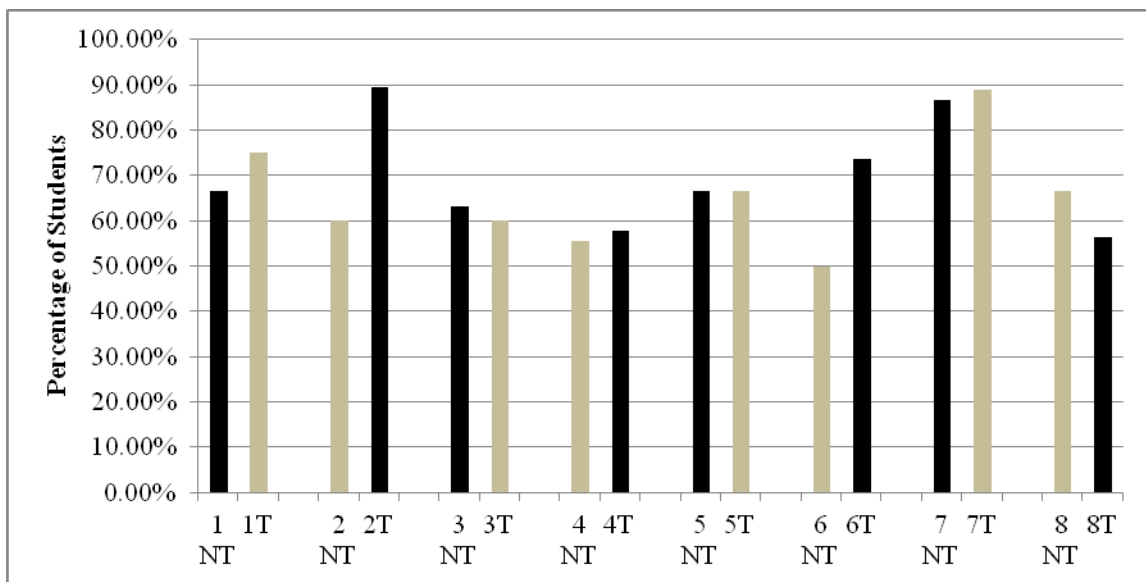


Figure 11. Comparison of the means of students' attitudes towards science lessons: non-treatment (N-T) vs. treatment (T), black = morning group, gray = afternoon group.

The subject of lessons 1NT and 1T was the life cycle of a frog. Lesson 1NT (non-treatment, morning group) had an approval rating of 66.7% (N = 18) whereas Lesson 1T (treatment, afternoon group) had an approval rating of 75% (N = 6). There was a +8.3% higher approval rating for the treatment lesson. The unpaired t-test revealed a p-value of

0.104 and a t-value of 1.692 (df = 24). This would be considered statistically insignificant.

The subject of lesson 2NT and 2T was facts about frogs. Lesson 2NT (non-treatment, afternoon group) had only a 60% (N = 10) approval rating. Lesson 2T (treatment, morning group) had an 89.5% approval rating (N = 19). The unpaired t-test revealed a p-value of 0.0001 and a t-value of 6.077 (df = 27). This is extremely statistically significant. I can say with at least 95% confidence that the treatment effect cannot have occurred by chance. Here, I believe that students having choices and being allowed to work together gave the inquiry-based lesson the advantage. Even if the mean performance score for both treatment and non-treatment is around 80%, students should be expected to work together. In the “real world”, scientists work as teams on their research. Working in teams is such a crucial life skill.

The subject of lessons 3NT and 3T was weather vocabulary. Lesson 3NT (non-treatment - morning) received an approval rating of 63.2 (N = 19). Lesson 3T (treatment - afternoon) had a 60% approval rating (N = 10). There was no difference for this pair of lessons when we consider academic performance as well as the students' attitudes towards the lesson. The unpaired t-test revealed a p-value of 0.488 and a t-value of 0.703 (df = 27). This would be considered statistically insignificant.

Lesson 4NT and 4T addressed the topic of bird facts. Lesson 4NT (non-treatment, afternoon) had a 55.6% approval rating (N = 9). For Lesson 4T (treatment, morning) there was a 57.9% approval rating (N = 19). The unpaired t-test revealed a p-value of 0.653 and a t-value of 0.455 (df = 26). There is no significant difference in the approval rating between Lessons 4NT and 4T.

The topic for lessons 5NT and 5T was classification of ocean animals. For Lesson 5NT (teacher-centered, morning) the approval rating was 66.7% (N = 18). The approval rating for lesson 5T (treatment, afternoon) was also 66.7% (N = 9). Incidentally there was also no difference in the mean performance score. I would point out that simply for the fact that twice the expected number of students said that the lesson was “super fun” or “amazing” shows just how powerful science instruction is to student engagement.

The focus for lessons 6NT and 6T was an outdoor experience. The approval rating for Lesson 6NT (non-treatment, afternoon) was only 50% (N = 10). Conversely, the approval rating for Lesson 6T (treatment, morning) was 73.7% (N = 19). This represents a 24% treatment effect. The unpaired t-test revealed a p-value of 0.0001 and a t-value of 4.882 (df = 27). I can say with at least 95% confidence that these results could not have occurred by chance. It is extremely statistically significant. This was one of those lessons that developed and blossomed right before your eyes. I was amazed to see how the students enjoyed exploring outside. So often, these suburban students arrive home to watch television, play video games etc. and never have an opportunity to go outside.

Lesson 7NT and 7T involved an exploration in the school’s science lab with live earthworms. The approval rating for Lesson 7NT (non-treatment, morning) was 86.7% (N = 15). The approval rating for Lesson 7T (treatment, afternoon) had an 88.9% (N = 9). The unpaired t-test revealed a p-value of 0.661 and a t-value of 0.445 (df = 22). This is not statistically significant. My students had never had a lab experience. Typically first grade students do not go to the science lab. Maybe they had never even had the opportunity to see live earthworms up close? For the inquiry lesson, the students were encouraged to ask some of their own questions and make hypotheses about what might happen. Here, I believe, the subject matter, rather than the method of presentation seemed

to be the reason for the high approval rating in both the treatment and non-treatment lessons.

Lessons 8NT and 8T were a pair of follow-up lesson focusing on facts about earthworms. The approval rating for Lesson 8NT (non-treatment, afternoon) was 66.7% (N = 9). The approval rating for Lesson 8T (treatment lesson, morning) was only 56.3%. The unpaired t-test revealed a p-value of 0.056 and a t-value of 2.014 (df = 23). This is not quite statistically significant. If I had allowed for slightly less than 95% confidence then I might consider that this is significant. I believe that the students felt more comfortable working alone or using the model I had set forth for them. Remembering that these students are English Language Learners, rigorous language demands often cause stress on the students. Providing a model and scaffolding the assignment for them might have helped the students feel more successful.

The two pairs of lessons that were resulted in a statistically significant difference in the means of students' responses were lessons 2NT/2T and 6NT/6T. In both of these instances the higher performing morning group (N = 19) received the treatment lesson. In all other lesson pairs the difference in the means was considered statistically insignificant.

The morning class showed no significant difference in the means between the four non-treatment lessons and the four treatment lessons. Could this be because the students are more consistent with their emotional responses to the lessons? Is it on the other hand that inquiry-based instruction was not significant in affecting the higher performing groups' emotional response to the lessons? Could it be that this group simply liked science, no matter how it was presented? This could be the case, though I wished that I had had the opportunity to determine the answer to the question.

The afternoon class, however, did show a significant gain in student attitudes. The non-treatment lessons mean positive response (approval rating) was 58.1%. The mean approval rating of the treatment lessons was 72.6%. This would be a 14.5% gain in student's positive attitudes towards science class. Though I could not say that the students in either class had an increased academic performance, I can say that the students in my lower performing group of English Language Learners showed a better attitude towards the science lessons when presented in a student-centered, inquiry-based lesson.

Here is another way to look at the attitudes. The mean of the percentages of positive responses are different between the non-treatment and treatment lessons. The non-treatment lessons received an average of 64.5% of the students choosing the positive response, whereas, only 71.0% of the students chose the positive response for the treatment lesson.

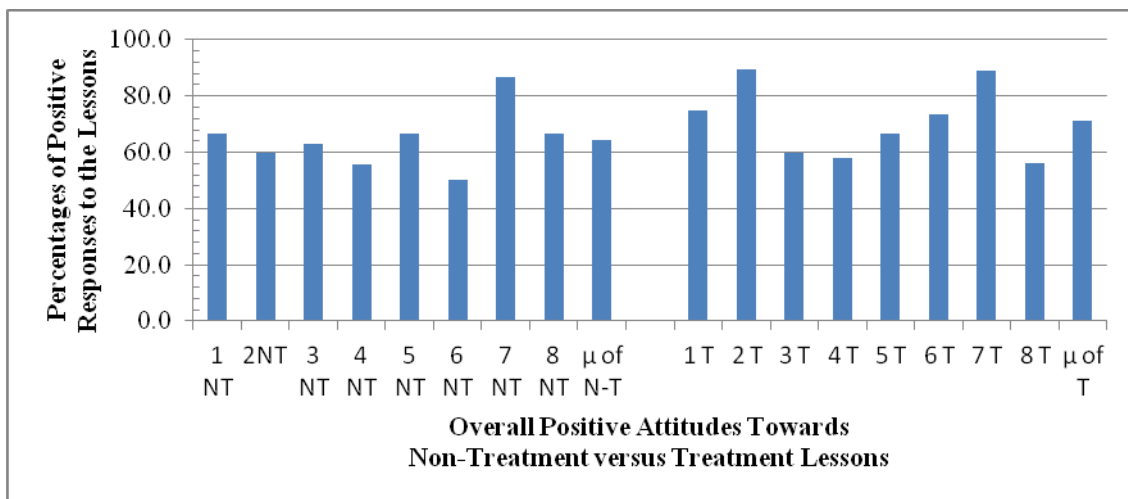


Figure 12. Comparison of the means of students' attitudes towards science lessons: non-treatment (N-T) vs. treatment (T) ($N = 29$).

Comparing the overall scores of positive responses for all lessons the paired t-test revealed a p-value of 0.0001 and a t-value of 3.974 ($df = 215$). I can say with at least 95% confidence that this extreme of results could not likely have been observed by

chance. This would mean that inquiry-based instruction did have an influence on the students' attitudes towards science.

In summary treatment does not have significant affect on students' performance scores for these initial activities/assessment given to the students. All of the lessons whether treatment or non-treatment were short i.e. twenty to thirty minutes. Can the students show adequate content knowledge in such a short lesson? Since I could only spare twenty to thirty minutes twice a week away from prescribed curriculum, I believe that the students could not really show me all their potential in science. I wish that I could use inquiry more often. What I really was measuring was students' attitudes towards the science lessons. Citing Figure 9 it appears that students' attitudes towards science lessons were significantly affect by inquiry-based learning. I also performed a Wilcoxon Rank-Sum test on this data that revealed that the treatment lessons rank average difference was higher by 2.5 ranks. This would indicate 95% confidence that the treatment lessons had an effect on students' attitudes towards the science lessons.

INTERPRETATION AND CONCLUSION

In this section, I will summarize the findings and make possible generalizations regarding the data. My quest was to see how inquiry-based learning might affect my English Language Learners' attitudes towards science. However I really began with my Action Research focus question regarding my own professional growth. I began with interviewing five of colleagues. I was hoping to gain some insight into what I need to become as a science teacher. If I want to become and inquiry-based teacher, then I need the support of my colleagues. These teachers now work with some of the students that were once in my class when they were in first or second grade. Though science may be interesting, the consensus among my colleagues was that the students do not have

confidence in their abilities. A common theme was that the ELL's become frustrated when they encounter common yet unfamiliar English words. My colleagues asked that primary teachers expose the students to reading of science literature. I incorporated books into several of my lessons. Also, my colleagues asked to give the students time to explore. When the students get to the middle grades (second through fifth) there is so much material for teachers cover and the students have not had many informal experiences with the topics. This puts the students at a disadvantage. How does expecting inquiry from my students affect me as a teacher? I would say that this connection and communication with lateral and vertical team members will be critical to my continued success.

After interviewing with my five colleagues, I analyzed the population for each of the two groups. I found that the morning class had a higher average reading level (G) in comparison with the afternoon group (F). All twenty of the parents from the morning group returned the consent form. A few of the parents from the afternoon class returned the form asking that their child not participate and several of the students did not return the consent form. Parent consent might also be a reflection on the parents support for homework or amount of time they have to take their children to informal science venues. The afternoon group population was only ten students with one student who was a non-reader, has frequent "family issues" and has had twelve absences this year. Here I reiterate my focus question regarding professional growth. Becoming a better teacher means knowing my students. Inquiry involves the whole child. It is not just curriculum that drives inquiry; it is the students' interests. I need to get to know my students on a personal level. What is it that gets them thinking?

In reference to my Action Research focus question regarding students' attitudes, I gave the two groups the Student Attitude Assessment I had prepared. It was interesting to note that, in general, the morning group seemed to have had previous positive experiences with many of the topics addressed in the Student Attitude Assessment. I had not intended to have this research discuss the differences between two different populations, but how inquiry-based learning affects students' attitudes. Since there was a difference in students' attitudes between the morning group (62.45%) versus the afternoon group (54.85%), there could be a significant reason to believe that these populations should be considered separate. After the treatment phase, the Student Attitude Assessment was given again. Neither the morning group nor the afternoon group showed a significant change in the mean of the percentages of positive responses on this assessment. The morning class's pre-treatment mean of the positive responses was 62.8% and 62.1% for post-treatment positive responses. The afternoon class's pre-treatment mean of the positive responses was 55.7% and 54.0% for the post-treatment responses. There was no measured treatment effect considering the topics addressed in this assessment. I can, however, say that these students seemed to have really enjoyed the worm lab/investigation. Whether the students had the non-treatment or the treatment lesson there was a dramatic spike in the positive responses towards earthworms. The morning class's pre-treatment survey showed 25% (N = 20) of the students with a positive response compared to 68.8% (N = 16) for the post-treatment survey. Similarly, the afternoon class's pre-treatment survey showed only 10% (N = 10) of the students with a positive response compared to 44.4% (N = 9) for the post-treatment students surveys. Students of this age especially are curious. No matter how the material is presented, it seems that they really enjoyed their first lab experience.

The second focus question for my Action Research was “How did inquiry-based learning affect students’ performance on content and vocabulary assignments and assessments?” For each of the eight topics, I presented two lessons. One lesson was teacher-centered and almost simply facts-based. The second lesson I presented as an inquiry-based lesson. These lessons would be characterized as open-ended, student-centered, hands-on and offering the students both choice and autonomy. Somehow it ended up with nearly all of the scores for both of the groups as well as non-treatment and treatment lessons means to be around 79%. I did not “compare apples with apples.” Students are human subjects and the populations were different. One group had a population of nineteen and the other had ten. The assignment or assessment used for each of the paired lessons was different. I cannot say that inquiry-based instruction had any effect on students’ content assignments or vocabulary. Please remember that this assignment/assessment was given on the same day the topic was introduced and taught. There was not much time to reach mastery for either treatment or non-treatment lessons.

I come back around to students’ attitudes, the heart of my Capstone Project, how does inquiry-based learning affect students attitudes towards science lessons. For the morning group there was not a difference in the means of positive responses between the non-treatment (70.83%, N = 19) and treatment lessons (69.35%, N = 19). However, for the afternoon class, there seems to be a significant difference. The mean of positive responses to the non-treatment lessons was 58.1% and for the treatment lessons, the mean was 72.6%. Also when comparing side by side Lesson 1A and 1B etc. five times out of eight the treatment lesson percentage of positive responses was higher than the non-treatment lessons. In the end, I showed that 71.0% of the students had a positive response to the treatment lesson compared to 64.5% for the non-treatment lesson. Considering

eight paired lessons and total population of 29, this is significant (t-value of 3.974). There is clearly at least a 95% confidence that the treatment effect was a coincidence.

I believe that as I look forward to my next few years of teaching, I want to continue the vertical and lateral communication. I need to know what other teachers are experiencing. I also believe that I want to form a group of teachers with whom we can grow as inquiry-based teachers. We need to teach the child, not just the curriculum. The relationship I have with the students is critical for me to be able to teach through some of their interests.

VALUE

I am still in the process of becoming an inquiry-based teacher. I know that on the inquiry continuum, I have a much potential for improvement before I feel confident in my facilitation of students' inquiry-based learning. Learning must come from within the student's own experiences. They must construct their own meaning. For years I lectured to the point beyond the students' abilities to pay attention. I presented activities that were thought up by me or some other curriculum writer. Certainly, I see the positives in inquiry-based learning for English Language Learners, and hope that my experiences might encourage other teachers to try this mode of delivery. I cannot generalize for other teachers' specific situations, but I can say that I feel that my influence on these young learners will pay off in years to come. I hope to find out that the majority of my students are being successful in science because I allowed them informal, hands-on, student-centered instruction that strengthened their English vocabulary.

Building vocabulary in second-language learners may be my goal, where as science is my medium for enhancing their English abilities and encouraging the student's curiosity about the natural world. Seeing that inquiry-based learning has a significant

effect on the students overall attitude towards science class (71.0%) versus teacher-centered lessons (64.5%), I would encourage other teachers to come on the quest with me to become inquiry-based facilitators. I am sure that many teachers would benefit from what I have learned.

Maybe other teachers and administrators will see the value in inquiry-based learning and develop cadres or professional learning communities as a result of this study. At present, I really do not have a support group at my campus who knows anything about inquiry-based learning. At my school, in my district and across the state, there are so many teachers with students whose first language is other than English. Inquiry-based learning allows the students to work together instead of listening to the teacher talk so much. English Language Learners who are struggling with understanding the teacher could benefit from the less formal atmosphere and the support they may feel from their classmates during inquiry-based lessons. Maybe I will be the catalyst or mentor for a few of my colleagues to help bring my campus to the state and national expectation for inquiry-based learning.

I agree that there are curriculum standards that must be taught. We as teachers must steer the students towards what they must know. However, I also believe that if the students enjoy themselves along the way, and are allowed to work in a less teacher-centered environment; they may have a greater chance to flourish. Inquiry-based learning requires the teacher to think beyond the curriculum and think about how the students might best acquire the knowledge. Teachers learn how to teach, should we also learn how students' learn? Good teaching is filled with elements of inquiry-based learning. I believe that giving my English Language Learners meaningful, hands-on, student-centered opportunities, they may be able to go well beyond their Limited English and thrive rather

than always struggle in science class. Students with a better attitude might have better confidence. If I have a great attitude about what I am teaching, will this too be evident in the students' attitudes? How might this affect the students' potential? Treatment did not have a significant impact on student content learning as measured in twenty to thirty minute lessons. Learning really is on-going throughout the school year and the students' academic career. As I introduce my students to inquiry-based learning, they become problem solvers and critical thinkers. We do not just want students to learn facts for a test. We want them to learn to work together and pursue knowledge, *scientia*. My measurements were very short range. How can I measure the students' growth over the weeks, semester, or year? I will be looping with the majority of these students and will be excited to continue to expose them to inquiry-based learning.

I am excited that my grade-level team members have expressed interest in working together to create some inquiry-based lessons for next year. They want to utilize this inquiry-based approach to reach out to their students as well. As I have shared articles with my vertical team members, I have been excited to hear their interest and enthusiasm. Often, these colleagues speak of how stressed that they are about "getting it all in" and not having time to allow the students to explore. According to state and national standards, inquiry and investigation should be sixty to eighty percent of science instruction for students in elementary. I would venture to say that this takes a lot of preparation on the part of the teacher. Working together with a team, combining efforts and individual skills could make preparation more productive. This kind of instruction is best when you have a collaborative work environment.

My grade level colleagues wished that they could have done the activities with me and created their own results. Once again inquiry is good teaching. So often teachers are

“bogged down” by curriculum and preparing the students for formal, high-stakes testing that, I feel teachers are reluctant to put the time and effort into making their lessons pertinent for their own specific students. We have lessons prepared for us at district level which are good lessons, but how do we as classroom teachers make these “canned” investigations more inquiry-based and engaging for the students? Can we access or create our own misconception probes? These would, of course, take time to develop. If we work on them as a team, would this lighten the load?

I wonder whether it was significant that six times out of eight the students selected by a stratified random sample for the afternoon group scored higher on their content/vocabulary assignments for their inquiry-based lesson. I would want to have the chance to possibly switch groups to compare data of the same population whether in the morning or afternoon. Could this make a difference in students’ performance? Is it possible that students would be better off learning science in the afternoon? Is there a difference in attitudes between English Language Learners and mainstream students? What would the result have been like if I had the opportunity to include the ELL’s from my grade level and not just my students? These would all be possible future research questions.

As I pursue becoming an inquiry-based teacher, I want to continue to study Vygotsky to really see how deeply I believe in constructivism. I need to re-visit Llewellyn’s *Inquire Within* (2007) to remind me of what becoming an inquiry-based teacher needs to consider. I would like to see what response researcher Okhee Lee has to my Action Research. Is there something in my research that is worthy of sharing at a state conference for teachers of English Language Learners or the National Science Teachers’ Association’s state conference? I want to get together with my team and truly plan ahead

for meaningful investigations for my young learners. I want to keep science fun for my students and working with my team will potentially create better lessons.

Is it any wonder that my former students who are now in fourth or fifth grade are having bad attitudes towards science if it does not have any relevance to them personally? Content and assessment are keys to learning but we must consider student engagement through fun investigations as the catalyst that gets the interest flowing.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD EXEMPTION



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
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MEMORANDUM

TO: Douglas Lymer and Walt Woolbaugh
FROM: Mark Quinn, Chair *Mark Quinn CJ*
DATE: December 6, 2012
RE: "How Does Inquiry-Based Learning Affect Attitudes Towards Science of First Grade English Language Learners?" [DL120612-EX]

The above research, described in your submission of December 6, 2012, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- ☒ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- ☒ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- ☐ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- ☐ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- ☐ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- ☐ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

Consent for Allowing Child Participation in Research

I agree to have my son or daughter participate research conducted by Mr. Douglas Lymer. Mr. Lymer is working on his Master's Degree at Montana State University – Bozeman, Montana. I understand that the project is designed to find out about students attitudes toward science content. I understand that my son or daughter will be one of about forty students participating in this study.

My son or daughter's participation in this project is completely voluntary. I understand that I will not receive any money for my child's participation. I may choose at any time for my son or daughter to stop participating without penalty. If I choose to stop my son or daughter from participating, no one will have bad feelings and there will not be any negative effects on student's grade.

Participation involves attending school during regular hours. Students will participate in science activities in Mr. Lymer's class, science lab or outdoors. Notes will be taken by Mr. Lymer during the project.

I understand that Mr. Lymer will not use my child's name in any reports using information from the research. My child's confidentiality in this study will remain secure. Records and data will be kept secure according policies which protect the identity of individuals involved in research, especially children.

Other than Mr. Lymer, administrators from my campus will not have access to these notes or transcripts. This precaution will prevent my individual son or daughter's comments from having any negative repercussions.

I understand that this research study is a part of the requirements for Mr. Douglas Lymer's university class entitled Implementing Action Research and his Capstone Project. His professor and classmates as well as other professional educators and interested individuals will be able to read trends and generalizations made from the research but will not have access to audio or video recordings, transcripts nor data specifically identifiable to my child.

I have read and understand the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study. I have been given a copy of this consent form.

Parent Signature Date

My Printed Name

Student Signature

Signature of the Investigator

For further information, please contact:

Mr. Douglas Lymer

(281)-744-5868 douglymer1@comcast.net

Consentimiento para Permitir la Participación de Infante en Estudio

Estoy de acuerdo en que mi hijo ó hija pueda participar en el estudio conducido por el Sr. Douglas Lymer. El Sr. Lymer está trabajando en su grado de Maestría en la Universidad del Estado de Montana –Bozeman, Montana. Entiendo que el proyecto está diseñado para entender y aprender sobre las actitudes que los alumnos tienen hacia la materia de las ciencias. Entiendo que mi hijo á hija será uno de cuarenta estudiantes (aproximadamente) participando en este estudio.

La participación de mi hijo ó hija en este proyecto es completamente voluntaria. Entiendo que no recibiré pago monetario alguno por la participación de mi hijo ó hija en el estudio. Puedo elegir en cualquier momento que mi hijo ó hija deje de participar en el estudio sin penalización alguna. Si decido que mi hijo ó hija deje de participar, nadie tendrá malos sentimientos y no habrá ningún efecto negativo en las calificaciones del estudiante.

La participación requiere la asistencia a la escuela durante horas regulares. Los estudiantes participarán en actividades de ciencias en la clase del Sr. Lymer, en el laboratorio de ciencias o afuera en los alrededores de la escuela. El Sr. Lymer tomará notas durante el proyecto.

Entiendo que el Sr. Lymer no usará el nombre de mi hijo ó hija en ninguno de los reportes que la información del estudio genere. La confidencialidad de mi hijo ó hija en este estudio se mantendrá segura. Todos los datos e información serán guardados con seguridad, de acuerdo a las políticas que protegen la identidad de los individuos involucrados en un estudio, especialmente niños.

Además del Sr. Lymer, ningún administrador de la escuela tendrá acceso a las notas y datos. Esta medida de precaución prevendrá que los comentarios de mi hijo ó hija tengan alguna repercusión negativa.

Entiendo que este estudio de investigación es parte de los requerimientos que el Sr. Lymer necesita para su clase de universidad llamada Implementación de Investigación en Acción (*Action Research*) y su Proyecto Final. Su profesor y compañeros de clases podrán leer tendencias y hacer generalizaciones basadas en el estudio pero no tendrán acceso a las grabaciones de audio ó video, datos ó información específica que identifiquen a mi hijo ó hija.

He leído y entiendo la explicación que se me ha dado. Todas mis preguntas han sido respondidas satisfactoriamente, y voluntariamente estoy de acuerdo en participar en este estudio. Se me ha entregado una copia de este consentimiento.

Mi FirmaFecha

Mi Nombre

Firma del estudiante

Firma del Investigador

Para mayor información, por favor contacte al Sr. Lymer. (281) 744-5868

douglymer1@comcast.net (correo electrónico)

Consent for Participation in Interview Research

I volunteer to participate in a research project conducted by Mr. Douglas Lymer, a Master's Degree student at Montana State University - Bozeman. I understand that the project is designed to gather information about perceptions and attitudes held by teachers and students. I will be one of approximately five people being interviewed for this research.

1. My participation in this project is voluntary. I understand that I will not be paid for my participation. I may withdraw and discontinue participation at any time without penalty. If I decline to participate or withdraw from the study, no one on my campus will be told.

2. I understand that most interviewees will find the discussion interesting and thought-provoking. If, however, I feel uncomfortable in any way during the interview session, I have the right to decline to answer any question or to end the interview.

3. Participation involves being interviewed by Mr. Douglas Lymer, a Master's Degree student at Montana State University - Bozeman. The interview will last approximately 15 - 20 minutes. Notes will be written during the interview. An audio recording of the interview will be made. If I do not wish to be taped, I will not be able to participate in the study.

4. I understand that the researcher will not identify me by name in any reports using information obtained from this interview, and that my confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

5. Faculty and administrators from my campus will neither be present at the interview nor have access to raw notes or transcripts. This precaution will prevent my individual comments from having any negative repercussions.

6. I understand that this research study/interview process is a part of the requirements for Mr. Douglas Lymer's university class entitled Implementing Action Research as well as his Capstone Project. His professor and colleagues will be able to read trends and generalizations made in the interviews but will not have access to the recordings nor complete transcripts.

7. I have read and understand the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

8. I have been given a copy of this consent form.

My Signature Date

My Printed Name

Signature of the Investigator

For further information, please contact:

Mr. Douglas Lymer

(281)-744-5868douglymer1@comcast.net

APPENDIX B

MORNING CLASS DEMOGRAPHICS

Morning Class Demographics

code	A.K.A.	Math BM rank	MOY IRL	IRL value	
IM1A	<i>Ruby</i>	17	D	4	
IM1C	<i>Denise</i>	4	H	8	
IM1D	<i>Matthew</i>	2	H	8	
IM2A	<i>Janet</i>	9	H	8	
IM3D	<i>Adam</i>	6	E	5	
IM4C	<i>Marie</i>	5	H	8	
IM4D	<i>Johnny</i>	19	D	4	
IM4E	<i>Ralph</i>	8	D	4	
LM1B	<i>Stephen</i>	16	E	5	
LM2B	<i>Virginia</i>	7	H	8	
LM2C	<i>Joseph</i>	1	H	8	
LM2E	<i>Rebecca</i>	10	J	10	
LM2F	<i>Henry</i>	18	G	7	
LM3A	<i>Lawrence</i>	13	H	8	
LM3B	<i>Stephanie</i>	11	G	7	
LM3C	<i>Donna</i>	3	H	8	
LM3E	<i>Emily</i>	15	G	7	
LM4A	<i>Marilyn</i>	14	G	7	
LM4B	<i>Shirley</i>	12	G	7	
		BM = Benchmark 1 = high, 20 = low		IRL = Independent Reading Level	
mean		10	G	6.89	mean
mode		#N/A	H	8	mode
median		10	G	7	median
range		1st - 19th	D - J		range
StDev		5.63		1.70	StDev
all math scores within 2XStDev.			all IRL's within 2XStDev		

APPENDIX C

AFTERNOON CLASS DEMOGRAPHICS

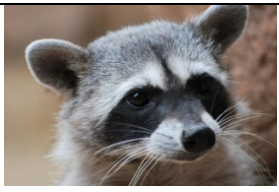
Afternoon Class Demographics

code	A.K.A.	Math BM rank	MOY IRL	
IA2D	<i>Ruth</i>	6	G	7
IA2E	<i>Harold</i>	5	D	4
IA3A	<i>Jack</i>	17	RR	0
IA3B	<i>Thomas</i>	1	J	10
IA3C	<i>Betty</i>	9	G	7
LA1A	<i>Jonathan</i>	7	C	3
LA2A	<i>Lillian</i>	12	I	9
LA2F	<i>Kimberly</i>	8	D	4
LA3E	<i>Beverly</i>	2	J	10
LA4D	<i>Ryan</i>	13	D	4
BM = Benchmark 1 = high, 20 = low IRL = Independent Reading Level RR = Reading Readiness (non- reader)				
	mean	8.0	F	5.80 mean
	mode	#N/A	D	4 mode
	median	7.5	F/G	5.5 median
	range	1st - 17th	RR - J	range
	StDev	4.97		3.33 StDev
all math ranks within 2XStDev			all IRL's within 2XStDev	

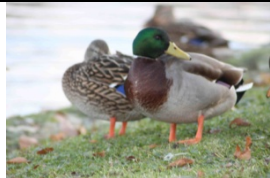
APPENDIX D

STUDENT ATTITUDE ASSESSMENT

Please circle the face that shows how you feel about each picture. This is voluntary.

Please Circle the face that shows how you feel about each picture. This is voluntary

APPENDIX E

STUDENT INTERVIEW QUESTIONS

Student Interview Questions – This is voluntary.

- 1) Have you ever taken a walk around the park? Y N How many times? ____ If no, would you be interested in taking a walk around the park?
- 2) Have you ever been somewhere to watch birds? Y N How many times? ____ If no, would you be interested in watching birds?
- 3) Have you ever stopped to watch clouds floating by and changing shape? Y N How many times? ____ If no, would you be interested in watching clouds?
- 4) Have you ever watched a caterpillar? Y N How many times? ____ If no, would you be interested in watching a caterpillar?
- 5) Have you ever caught a butterfly? Y N How many times? ____ If no, would you be interested in catching a butterfly?
- 6) Have you ever gone somewhere to look up at the stars? Y N How many times? ____ If no, would you be interested in looking up at the stars?
- 7) Have you ever gone to the zoo? Y N How many times? ____ If no, would you be interested in going to the zoo?
- 8) Have you ever planted flowers? Y N How many times? ____ If no, would you be interested in planting flowers?
- 9) Have you ever been hunting for bugs? Y N How many times? ____ If no, would you be interested in hunting bugs?
- 10) Have you ever collected leaves? Y N How many times? ____ If no, would you be interested in collecting leaves?
- 11) Have you ever made a healthy snack? Y N How many times? ____ If no, would you be interested in making a healthy snack?
- 12) Have you ever been to a science museum? Y N How many times? ____ If no, would you be interested in going to a science museum?

APPENDIX F

LESSON 1A (NON-TREATMENT)

Lesson 1A Rubric (Non-treatment)

Overall Score _____

Student Code _____

Vocabulary

eggs _____beginning _____

tadpole _____next _____

froglet _____later _____

adult _____life cycle_____

Points Possible
(this section)8Points Earned
(this section)_____

Presentation

Use of arrows to show cycleStages in correct order (3pts)

four(2 pts)_____two (1 pt)_____YN

Points Possible
(this section)5Points Earned
(this section)_____

APPENDIX G

LESSON 1B (TREATMENT)

Lesson 1B Rubric (Treatment)

Overall Score _____

Student Code _____

Vocabulary

eggs _____beginning _____

tadpole _____next _____

froglet _____later _____

adult _____life cycle_____

Points Possible
(this section)8Points Earned
(this section)_____

Presentation

Use of arrows to show cycleStages in correct order (3pts)

four(2 pts)_____two (1 pt)_____YN

Points Possible
(this section)5Points Earned
(this section)_____

APPENDIX H

LESSON 2A (NON-TREATMENT)

Important Frog Facts

- 1) Baby frogs need to live in water until they grow into adult frogs.
- 2) Frogs have a sticky tongue to catch their food.
- 3) Frogs hear sounds without ears. They have a drum on the sides of their head.
- 4) Frogs have two short legs in front and two longer legs in back.
- 5) Frogs' skin needs to stay a little wet all the time.

Draw some pictures on the back.

APPENDIX I

LESSON 2B (TREATMENT)

Lesson 2b T

Student Code _____

K	W	L
What do we know or think we know about frogs and toads?	What do we want to find out? What questions do we have about frogs?	What did we learn?
	Important Words amphibian carnivore tadpole life cycle	

APPENDIX J

LESSON 3A (NON-TREATMENT)

Weather Facts

Rain – The drops of water falling from the clouds.

Lightning – Electricity passing between the ground and the clouds or between clouds.

Storm – Lots of rain falling in a few minutes. Sometimes there might be strong winds, lightning and thunder.

Clouds – A collection of tiny drops of water in the sky.

Warm, moist air mixes with colder air. Then the water drops in the clouds cannot stay in the clouds anymore. So they drop out of the clouds as rain.

Lesson 3a N-T Rubric

Student Code _____

PictureStatements

none(0) ____ none (0)____

minimal (1) ____ 1 copied (1)____

nice (3)____ 2 copied (2)____

special (5)____ 1 original (2)____

2 original (3)____ Labels Y (2) N (0)

Points Possible10

Overall Score _____

APPENDIX K

LESSON 3B (TREATMENT)

Weather Words

Aa	Bb	Cc	Dd	Ee
Ff	Gg	Hh	Ii	Jj
Kk	Ll	Mm	Nn	
Oo	Pp	Qq	Rr	
Ss	Tt		Uu	
Vv	Ww	Xx Yy		Zz

APPENDIX L

LESSON 4A (NON-TREATMENT) AND LESSON 4B (TREATMENT)

Bird Knowledge Pre-Test

1) Baby birds hatch from an egg...

- a) The mother bird lays the eggs on the leaf of a plant and in a few days, the baby bird hatches as a caterpillar.
- b) The mother bird lays the eggs in a nest and must sit on them to keep them warm for several weeks until baby chicks hatch.
- c) The mother bird lays the eggs in the water. When they hatch they look more like fish than birds.

2) Birds are covered with...

- a) hair
- b) scales
- c) smooth skin
- d) feathers

3) Some birds fly away to far off places where there is plenty of food for them. This is called...

- a) camouflage
- b) migration
- c) hibernation
- d) counter shading

4) Which one of these birds catches food with their feet?

- a) goose
- b) eagle
- c) hummingbird
- d) chicken

5) Please write on the back of this paper some places where birds live.

APPENDIX M

LESSON 5A (NON-TREATMENT)

Mammals

d _ _ ph _ n

_ ea _ _ on

w _ _ r _ s

wh _ _ _

Fish

sh _ _ _

cl _ _ nf _ sh

h _ mm _ rhea _

Birds

pe _ gu _ _

p _ li _ a _

s _ a _ _ ll

“Soft” Sea Animals

_ qu _ _

_ _ to _ us

Animals with Shells

k _ ng _ r _ b

shr _ _ _

l _ b _ te _

Other Sea Animals

APPENDIX N

LESSON 5B (TREATMENT)

Ocean Animals

Mammals

Fish

Birds

“Soft” Sea Animals

Animals with Shells

Other Sea Animals

APPENDIX O

LESSON 6A (NON-TREATMENT)

Outdoor Observations

1) When there is _____ on the soil, it becomes _____.

2) The _____ of some plants do not look _____ when they are new.

3) During late

the _____ is not growing.

4) Only a few _____ are on the playground.

They seem to be looking for

Word Bank

Winter trash birds moisture grass

leaves slippery green tree acorns insects

APPENDIX P

LESSON 6B (TREATMENT)

Outdoor Observations

I found

I noticed that

It was interesting that

I found

I noticed that

It was interesting that

APPENDIX Q

LESSON 7A (NON-TREATMENT)

Worm Lab

Materials: You will need...

1 styro-foam plate	2 coffee stir sticks
1 plastic spoon	2 centimeter rulers
2 hand lenses 1 red worm	
1 cup of watermoist potting soil	

Safety Reminders

- 1 Stay seated at your table.
- 2 Only touch the worm with the coffee stir stick.
- 3 DO NOT EVER poke the worm.
- 4 Do not touch your eyes or mouth.

Watch the worm for one minute. What happened?

GENTLY touch the worm with the coffee stir stick. What happened?

Using the plastic spoon put a **small** amount of water on top of the worm. What happened?

Put **ONE** scoop of potting soil on the plate and wait one minute. What happened?

Using the **centimeter** ruler, measure how long the worm is. "Our worm measures ____ centimeters long". Draw your worm.

Using the hand lens, look at your worm. Write what you see.

Draw what you see using the hand lens.

APPENDIX R

LESSON 7B (TREATMENT)

Worm Investigation

Safety Discussion

Discuss with your team safety expectations during science lab.
Choose one person to write down your safety reminders. Important – you may not hurt your worm in any way.

Materials – choose two people to collect the following items for your investigation.

1 styro-foam plate 2 coffee stir sticks
1 plastic spoon 2 centimeter rulers
2 hand lenses 1 red worm
1 cup of watermoist potting soil

What would happen if you touched the worm with the coffee stir stick?

I think that _____

–

Choose two people to touch the worm. What happened? _____

–

What would happen if you poured some water on the worm?

I think that _____

Choose one person to pour some water on the worm. What happened? _____

What would happen if you tried to pick up the worm with a coffee stir stick?

I think that _____

Choose one person to try to pick up the worm. What happened? _____

I wonder why a worm _____

I wonder if a worm _____

I wonder what a worm _____

I wonder where a worm _____

I wonder when a worm _____

APPENDIX S

LESSON 8A (NON-TREATMENT)

Worm Questions

1)Where do worms live? _____

2)What do worms eat? _____

3)What do worms never eat? _____

4)How do worms breathe? _____

5)Where is a worm's **posterior**? _____

6)Does a worm need to stay dry or moist to keep alive? _____

7)Does a worm come out at night or during the day time? _____

What else do you see?

h _ _ _

_ gg s _ ck

p _ st _ _ ior

APPENDIX T

LESSON 8B (TREATMENT)

Worm Scavenger Hunt

Work together with your team. Look for the answers to the puzzles. You should use the words in the word bank to fill in the blanks. You may use books or internet. Share your ideas with others. Write on the back anything else that you found interesting.

Word Bank

nightrootsskinmeatleaves

plantstunnelsmovemoistvegetables

Worms have little hairs on their body to help them to

Worms do not eat

Worms eat dead _____ and rotting _____

Worms breathe through their

Worms need to always stay _____

Sometimes at _____ when it is raining worms will come out of the ground.

Worms dig _____ in the ground. Later water and the _____
of plants fill up the holes.