# DETERMINING THE EFFECT OF USING OUTDOOR INSTRUCTION ON INCREASING STUDENTS' ACADEMIC ACHIEVEMENT AND ATTITUDES TOWARDS THE ENVIRONMENT

by

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# ABSTRACT

Students today are less connected to the outdoors and the environment. Students spend less time outdoors than their parents, which has made students less comfortable with being in the outdoors. This purpose of this study was to determine the effectiveness of utilizing outdoor education on student achievement in science, and to increase students' attitudes towards environmental issues and the outdoors.

Lessons were taught in an outdoor classroom and students were given pre- and post-test content assessments to measure growth in their learning. Students also filled out pre- and post-treatment surveys and participated in small group interviews to determine changes in their attitudes towards the outdoor learning experience, and towards the environment.

Overall, students showed statistically significant growth in their learning from pre- and post-test scores in the unit of instruction that utilized outdoor instruction. Although quantitative results of pre- and post-treatment surveys were not statistically significant, comments from the small-group student interviews conveyed the effectiveness of utilizing outdoor education for learning, and for increasing motivation to learn about, and be in, the outdoors.

# INTRODUCTION AND BACKGROUND

Today, more than ever, students spend less time outdoors and more time utilizing and consuming technology. Since students today spend less time outside, they feel less comfortable being outdoors, and as a result less connected to the environment. My own experiences in the outdoors were quintessential to my appreciation for, and ultimately understanding of, environmental science. I think that today's students are not getting the outdoor exposure that was so important to developing my own passion for science and learning. Therefore, the purpose of this Action Research (AR) study was to determine the efficacy of utilizing outdoor education to potentially increase students' learning about, and attitudes towards, the natural environment. The primary research question was "Does utilizing outdoor instruction have an impact on students' learning?"

## Research Sub-questions

1. Does learning in an experiential outdoor setting increase student understanding of topics in Environmental Science?
2. Does learning in an outdoor setting increase students' motivations towards learning about topics in Environmental Science?
3. Does learning in an outdoor setting increase students' positive attitudes towards being outdoors, and caring about environmental issues?

## Instructional Context

The context of this AR study took place in a ninth-grade high school Honors Environmental Science classroom at Penncrest High School. Penncrest High School has approximately 1,300 students in grades 9-12. The school is part of the Rose Tree Media

School District, which is situated in Media, PA. The district is considered to be mostly suburban, with approximately 16% of the students identified as economically disadvantaged, and 17% of the students are typically placed in the special education program.

The Environmental Science Honors course is the middle of three academic track levels at the high school, and overall, the Honors courses are designed as a college preparation track. The students involved in my AR study were in heterogeneous classrooms with a varying range of academic needs and abilities. Even though the school utilizes a tracked approach to classes, the Honors courses have a tendency to include students of all ability levels, for example, several students had IEP’s for academic support. Students have a preview of many of the topics taught in Environmental Science from their middle school science coursework, but learn about these topics at a much greater depth in the Honors course.

Generally, students enjoy the class and content within the course, but seem to have very little real-world connection to the specific topics taught in environmental science. The goal of this study was to provide an opportunity for the students to learn about environmental science first-hand, while also being immersed in the actual setting they were learning about.

## CONCEPTUAL FRAMEWORK

The purpose of this study was to determine the impact of using outdoor education on student learning and student attitudes towards the environment and the outdoors. I began my AR research with a review of the literature, which showed that today’s students spend less time outdoors, more time utilizing personal electronic devices, and feel less of a connection to the outdoors. The literature also showed that increased time spent outside in an instructional setting increases student academic performance and enhances attitudes toward the environment.

## The Problem

With increasing global populations and greater pressures placed on our Earth's ecosystems, it is more important now than ever, that we have a scientifically educated population to deal with some of the greatest environmental challenges we face, e.g., including issues like climate change and human impacts on natural environments (IPCC, 2014; AGO, 2011). However, Blumstein and Saylor (2007) cite that only about 20% of the population is considered to be "scientifically literate" (p. 974), a daunting figure given that the 2014 Intergovernmental Panel on Climate Change (IPCC) concluded with "very high confidence" that climate change and associated events will result in "pervasive and irreversible impacts for people and ecosystems" (IPCC, p. 8). With the increase in human populations in the United States and globally, and the expected continued increase, there has been significant fragmentation of habitats, pollution of water, and disruption to native ecosystems, "whose full consequences are yet to unfold" (AGO, p. 3). Therefore, I think it will be today's generation of students who will work to solve tomorrow's environmental problems.

In a summary of much of the available research on the impact of outdoor education on students, Berns & Simpson (2009) describe the book *Last Child in the Woods*, by Richard Louv (2006), as possibly "the most influential environmental science book of the first decade of the 21$^{st}$ century" (p. 80). In his book, Louv (2006) contends that "today kids are aware of the global threats to the environment, but their physical contact, their intimacy with nature, fading." Louv (2006) labels this trend experienced by today's students as "nature-deficit disorder" (p. 99). In the report, *Americas Great Outdoors (AGO),* commissioned by the Department of the Interior (2011), it was determined that students spend about half as much time outdoors as their parents did. Much of this time loss of time spent indoors is due to the increase in technology usage by children (James & Williams, 2017); where today, students spend as much as seven hours a day with media, but only about thirty minutes outside (AGO, 2011). In one of the thousands of interviews Louv (2006) conducted with children concerning their perceptions of nature and the outdoors, one child explained, "I like to play indoors because that is where all the electrical outlets are" (p. 10).

Due to the decrease in their familiarity with the outdoors, due in part to a lack of time spent outside, students have developed fears associated with being outside, likening the outdoors as being "remote, mysterious, and frightening" in nature (James & Williams, 2017, p. 60). Also, children's lack of previous exposure to the outdoors increases their anxiousness about safety and confidence in the outdoors (James & Williams, 2017; Kuru & Pamberg, 2000). Some students are also not getting exposure to the outdoors due to their own parents' fears associated with allowing children to play and explore outside without supervision. With parents less comfortable and willing to let their children play outside, fewer children are getting the opportunity to experience nature and become familiar with the outdoors, as previous generations of children have been afforded (Little, 2015). Also, Americans today do not hold the same reverence in experiencing recreation in the outdoors as previous generations due to today's families having "busy schedules, shifting cultural norms, financial barriers, and the lure of new technology" (AGO, 2014, p. 21). In addition to unfamiliarity with the outdoors arising due to new societal norms, changes in education are also limiting students' exposure to the outdoors.

In educational settings, students are spending less time outside for recess due to limitations associated with more emphasis on standardized and mandated testing in our "test-centric" era (Louv, p. 99). James and Williams (2017) explain that as schools grapple with realities of needing to perform on mandated tests, educators have decreased the scope of curriculums to allow more time for test preparation to meet proficiencies in math and reading. They cite that there is now an emphasis on testing in schools as a priority, and "consequently, untested curriculum and time-intensive, student-centered, experiential learning that integrates subject matter in meaningful ways have been deemphasized or eliminated" (p. 59). In many cases, in order to:

> prepare their students for the high-stakes tests, teachers often rely on time-efficient instructional models that teach lower level fact and skill acquisition through teacher-centered lecture, drill, and rote memorization. Much research indicates that active, subject-integrated, experiential, in-context learning is the most effective way to reach students (James & Williams, 2017, p. 59).

Blumstein and Saylan (2007) cite that fostering learning that includes higher-order thinking is imperative so that they have the ability to "evaluate complex information and make decisions about things we can't currently envision" (p. 975). Despite the fact that using hands-on instruction and application of high order thinking skills increases student learning, we find that due to "increased pressure for students to perform well on the tests, many teachers are relying on instructional strategies that increase the amount of exposure to the test-aligned curriculum, rather than emphasizing application of the curriculum" (Faulkner & Cook, 2006).

What is Experiential Education?

In his famous work *How We Think* (1910), educational philosopher John Dewey describes the importance of the experience in the journey of the learning process. He describes how a student that only focuses on the end learning result, "alters work to drudgery", and the learner will not enjoy and appreciate the process of getting to the learning goal (p. 218). Dewey (1910) describes the "ideal mental condition" as one that allows for both play and seriousness in learning (p. 218). This is the exact opportunity that experiential education provides. In an overview of the utilization of experiential education in K-12 Canadian schools, Breunig & O'Connell (2008) cite the Association for Experiential Education's definition for experiential education as "both a philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflection to increase knowledge, develop skills, and clarify values" (p. 43). Experiential education allows students to take on a more hands-on approach to learning and fosters a learning environment that promotes relevancy and authenticity to learning (James & Williams, 2017). There is a wealth of research that supports the use of experiential education as a means to increase student achievement and motivation. In his comprehensive study of the effectiveness of experiential education on student achievement, Mohan (2015) looked at the Living Environment, Chemistry, and Earth Science New York Regency test scores among more than 1900 students learning in an experiential learning environment, and compared them to approximately 5600 students in a traditional learning setting. In his analysis of both inferential and descriptive statistics, he observed that students who received experiential instruction had statistically significant higher mean scores than those who experienced traditional education. The study also found, also at a level of statistical significance, that students in experiential education programs scored higher on critical thinking questions. In this study, Special Education students and English Language Learners (ELL) participating in experiential education programs also outperformed their counterparts in traditional educational programs. Many studies, across student ages and disciplines, have concluded the same idea, i.e., that experiential learning increases student engagement and achievement (McDavitt, 1994; Mohan, 2015; Baynes, Gookin, Paisley, Rathunde, Schumann, Sibthorp, 2011).

Despite the importance of learning about environmental science in an experiential way, there is a trend towards using more direct instruction approaches in schools that will have an overall negative impact on student learning. Blumstein and Saylan (2007) promote the importance of applying and manipulating data in a science class, not just memorizing discrete facts. A review of the literature concludes that outdoor, experiential-based education is more effective than traditional in-class methods at promoting student learning in science. James and Williams (2017) conclude that:

> “The value of school-based experiential outdoor education is evident. It connects classroom-based learning with in-context field-based experiences. It is effective in engaging all students in active, experiential, environmental science. It is successful in motivating the apathetic and bringing learning alive for those who are unsuccessful in more traditional learning contexts. It builds confidence in those who have a fear of the unfamiliar wilderness. School-based experiential outdoor education is, indeed, beneficial (p. 61)”.

Furthermore, as discussed in Pasquier and Narguizian (2006), outdoor field trips and education can provide opportunities for students to learn in an interdisciplinary manner and provide authentic learning experiences that integrate information learned in the classroom in a meaningful way (p. 33). Unfortunately, however, as Louv (2016) explained, there is less opportunity for today's students to learn in nature and experience the outdoors to learn environmental science (p. 59). The way students are learning environmental science does not align with how research suggests they should be learning. These trends also limit opportunities for students to be outside and develop an intrinsic interest in the environment.

As cited in AGO (2014), increasing peoples' exposure to the outdoors releases stress and anxiety, fosters learning, and promotes social and physical health (p. 3). Also, Palmberg and Kuru (2000) contended that:

> "…various activities in outdoor education can stimulate environmental education and nature studies in suitable ways so that pupils will learn about and experience nature while, at the same time, they learn action strategies to protect it. Experiences in the outdoor activities offer great possibilities for the development of a strong empathic relationship to nature among pupils (and their teachers!) (p. 36)".

Having positive experiences outdoors increases the likelihood of wanting to be outdoors and promotes mental and physical health, which will reinforce someone's desire to be outdoors and care for the environment. In their study, Kenney et al (2003) implemented an outdoor education program for students. They concluded from nterviews with students and teachers that students garnered a better appreciation for the outdoors, enjoyed being in their outdoor learning environment, and were engaged by the outdoor activities. The study observed that students were "seeing the outdoor space as their own and feel more of a role or obligation in caring for it" (p. 23). Based on my review, I think this is a first step towards raising awareness and developing concern for the environment among students.

Summary of Review Literature

The review of the literature also indicated to me that today's students spend much less time indoors, often as a result of distractions related to technology, or due to unfamiliarity, or a reluctance on behalf of parents to allow their kids outside unsupervised. This decrease in time outside has left many children with less of a personal connection to the outdoors, and an apprehension about being outside in nature. Also, educational policy changes have caused educators to narrow curriculums, and utilize more teacher-centered instructional techniques that are catered toward passing state and nationally mandated exams. Despite most teachers being aware that students learn best through experiential education, many have forgone these types of instruction in favor of preparing students for the mandated assessments. This has caused a decrease in outdoor experiential educational opportunities for students, which further disconnects them from the outdoors, and the environmental issues we face. A review of the research shows that taking time to implement outdoor experiential teaching increases students' attitudes towards being in the outdoors, increases awareness about environmental issues, and increases student comprehension of science topics, when compared to traditional in-class instructional methods.

## METHODOLOGY

The purpose of this AR study was to determine if utilizing outdoor education would have an impact on students' learning and also have an impact on students' attitudes towards the outdoors. Students today spend less time outside, and therefore do not have as much experience within the environment that they are learning about. The intervention for this study utilized an outdoor classroom setting for one unit of instruction on ecology with a group of 67 ninth grade Honors Environmental Science students across three classes. Students spanned the spectrum of academic abilities, with 10 students having IEP's for learning support, and one student having a GIEP for advanced abilities. The Honors track is considered to be for students that are college-bound. The Environmental Science course is designed to give students a strong basis in all of the natural sciences, before moving on to biology, chemistry, and physics in subsequent years. The Methodology for this project has been approved by the MSU Institutional Review Board (Appendix A).

## Intervention

For the intervention, most student learning (weather permitting) during this research investigation took place outside in an outdoor classroom setting. The teacher spent several of the days included within an ecology unit teaching in the outdoor classroom setting, thus utilizing the outdoor learning space to maximize experiential learning opportunities generated outdoors. The main themes of the ecology unit included: food webs, energy flow within the ecosystem, species niches, and natural cycles within an ecosystem. The instructional unit took place during approximately 15 44-minute class periods over a three-week period.

This outdoor classroom was a circular area in the woodlands adjacent to the school, and the area is arranged with scattered seating and tables. There are approximately three acres of mature deciduous forest around the classroom that were available for the instructional activities. There is a small stream that runs through the wooded area, as well as a water retention basin adjacent to the wooded classroom area. The study included activities that had students utilizing all of the outdoor areas.

In addition to the outdoor locations, there was a chalkboard on site, and students had access to their Chromebooks. The instruction included a variety of direct instruction, cooperative learning, and experiential learning activities. Several experiential activities were implemented as part of the intervention. For the first project, students collaborated in small groups to make a poster of the food web of species living in the area of woods within the outdoor classroom setting. Students took place in a scavenger hunt for examples of the water cycle, carbon-oxygen cycle, and succession in the outdoor classroom setting. The intervention also included a scavenger hunt to find examples of each of the niches discussed in the outdoor classroom setting. Overall, the intervention strategy was to get students learning outside in an authentic manner, immersed in the same environment that they were learning about.

Data Collection

Both quantitative and qualitative data were used to measure student learning and attitudes towards their experiences outside. Quantitative data was gathered through a pre- and post-test (Appendix B) within an ecology instructional unit where outdoor experiential education was utilized. These scores were measured for growth. The pre- and post-test questions were developed from the unit objectives sheet, which aligned with the state standards.

Also, students were interviewed after their experiences to reflect on their learning, and illuminate their potential changes in attitude based on the experience (Appendix C). In his work, Howden (2012) references a “What? So What? Now What” model for students reflecting on outdoor experiences. The idea is to get students to summarize what they did, why it was important or relevant, and what implications the experience will have going forward. In my study, students were interviewed within Howden’s framework, and were also asked if their experience learning outside had an impact on their answers to the “What? So What? Now What” model.

In a study that implemented an outdoor educational program, Kenney et al. (2003), utilized quantitative Likert Scale surveys, as well as qualitative open-ended surveys. Also, interviews were given to administrators and staff, and the responses were pooled and summarized to determine key factors toward successful implementation of the program. In my AR study, students were also given pre- and post- lesson tests to measure gains in knowledge as a result of the lessons. This particular component of my AR study covered both the attitudes of the students, as well as academic achievement. My study also utilized pre- and post-treatment Likert-Scale surveys (Appendix D and Appendix E), content based pre- and post-test questions, and open-ended survey questions to acquire data to assess whether outdoor instruction changed students’ attitudes towards being outside, as represented in the Triangulation Matrix (Table 1).

Students were also selected for interviews based on their pre- and post-surveys and tests. Students were selected to represent a variety of attitudes and academic achievement within the unit. In addition, students were selected to represent groups from the following categories: enjoys learning in the outdoors, does not enjoy learning in the outdoors, showed academic growth in intervention, did not show academic growth in the intervention. This Action Research project was approved for exemption by the MSU Institutional Review Board, and was in compliance for working with human subjects.

Table 1
*Triangulation Matrix*

Focus Question: Does utilizing outdoor instruction have an impact on students' learning?

| Sub-questions | Data Source | | |
|---|---|---|---|
| Sub-question 1: Does learning in an experiential outdoor setting increase student understanding of topics in Environmental Science | Pre-Test | Post Test | Student Interviews |
| Sub-question 2: Does learning in an outdoor setting increase students' interests towards learning about topics in Environmental Science? | Pre-Intervention Survey | Post-Intervention Survey | Student Interviews |
| Sub-question 3: Does learning in an outdoor setting increase students' positive attitudes and comfort-levels towards being outdoors, and caring about environmental issues? | Pre-Intervention Survey | Post-Intervention Survey | Student Interviews |

## DATA AND ANALYSIS

The results of the pre- and post-test content assessments of students learning for those who participated in the experiential outdoor setting indicate that students demonstrated growth in their learning. The students had an average growth of 42.6% from pre- to post-test scores ($N$ = 55, SD = 9.1) for the unit of instruction. From these scores, the normalized gains were calculated with an average value of 0.7008, which indicates the treatment increased student understanding on average of 70.08% from pre- to post-test. A two-tailed paired T-Test was calculated from the pre- and post-test scores, which yielded a value of $1.34x10^{-34}$, which indicates a statistically significant difference ($p< 0.0001$) between pre- and post-test scores, with the null hypothesis stating that there was no difference in scores between pre- and post-test. As shown in Figure 1, there was significant growth in overall scores, with no overlap between the fourth quartile in the pretest and the first quartile in the post test.

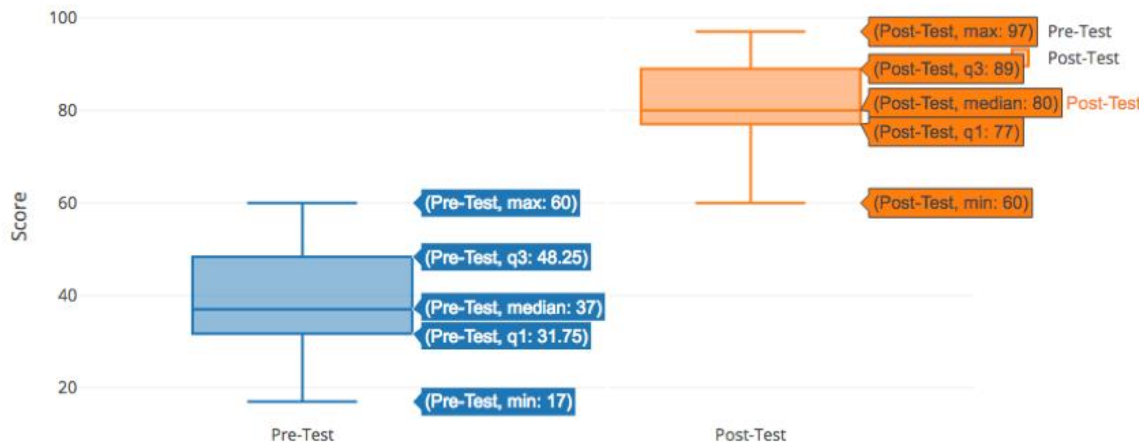


*Figure 1*. Box and whisker plots of pre-test score (blue) and post-test scores (orange), showing score minimums, Q1, medians, Q3, and maximum scores, (*N* = 55).

Of the students surveyed, only 13% reported saying that they did not learn better when outside, but there was not a significant difference in Likert values in pre- and post-treatment responses. Responses from small group interviews supported that the students learned better when outside. One student explained that "…we were talking about abiotic and biotic factors, and that was easier to learn outside because we were there actually seeing and doing it". Another student stated that, "doing things hands-on helps me remember; you remember experiences more than what you learn in a classroom". Furthermore, some students explained the general benefits of hands-on approaches outside, describing that, "when I can see it, and touch it, I learn better than then when looking at a picture in the classroom." From these data analysis results, I think it can be concluded that students had an increased understanding of topics in environmental science from impacts of the outdoor treatment.

Student pre- and post-treatment Likert surveys did not show statistical change in attitudes of the students in regards to their interests in learning about environmental science as a result of the treatment. Overall, as can be seen in Figure 2 located in Appendix F, student responses indicated they had positive views of learning in the outdoors before and after the treatment; with all mean Likert scores for both pre-and post-tests for attitudinal questions exceeding a score of 2.5 out of 5, but not with a significant difference when comparing pre- and post-treatment. This is clearly seen in the data that is summarized in Figure 2 in Appendix F, where dark green and light green indicate positive views, yellow as neutral views, and orange and red as negative views.

Small group student interview responses did support that learning in the outdoor environment increased student interest towards learning about environmental science. One student explained being outside impacted their attitudes positively by stating, "I get more energetic and more enthusiastic towards environmental science and participate more than when I am inside." Also, students explained that their experiences outside increased their interests in the subjects when they were at home. One student explained that they are excited to see what we learned in our classroom out in their daily lives by saying "…when you go to Ridley Creek State Park you can actually see what you learned outside in our class." Overall, there was not enough support to claim that the treatment had a statistically significant impact on students being more interested and motivated towards learning about topics in environmental science, but the small group interview data suggests a positive association.

As seen in Figure 2, quantitative Likert data related to the students' comfort levels with being in the outdoors was positive overall, with mean scores all above a score of 2.5 out of 5; however, there was not a statistically significant change in Likert scores before and after treatment. With that in mind, student interview responses overwhelmingly indicated to me that learning outside increased positive attitudes and comfort outside. Students explained in the interviews that being in the outdoors positively increased their moods, and made them less stressed. One student exclaimed that it was "more freeing to be outside, than crammed in a classroom" and that "…everyone is in a better mood". Many students also mentioned that the more time spent outside, the more familiar they became with being outside, stating that "…overtime we get more accustomed to being outside and more used to it" and "I would like to go outside even more", which was a direct result of their experience. Some students even noted that it had an impact on their whole day when they anticipated our outdoor lessons by detailing that "a couple periods before I realized, 'Oh my gosh' we are going outside for science, and I get a lot happier, I can't wait to go to fresh air". It is important to note that during the student interviews, students did not mention that they cared more about the environment as a result of the treatment. The data does show that students have positive views of the environment and being outdoors. Overall, the quantitative Likert data does not statistically support that the treatment had an overall impact on changing students' attitudes towards the outdoors and wanting to be outside. However, the small group interview responses indicate that the treatment reinforced positive views students already held on outdoor education impacting their attitudes towards the outdoors and environment.

## INTERPRETATIONS AND CONCLUSIONS

Utilizing outdoor experiential learning does work in the framework of high school science education. Students showed significant growth in their learning during the treatment unit. It could be argued that utilizing experiential outdoor education is not efficient, but research and data show that it is effective. The average gain from the pretest to the post test was 42.6% with a standard deviation of 9.2. The sentiment of the outdoor education was best summarized by one of the students in the small group interview when they stated, “Doing things hands-on helps me remember; you remember experiences more this way than what you learn in a classroom”.

The quantitative data from Likert surveys does not statistically show treatment resulted in students being more interested in learning about topic related to environmental science, but group interviews showed that the treatment had a positive impact on students’ interests. However, students expressed positive attitudes about their interests towards learning about environmental science because of their experiences outside in the classroom. One student stated that when they are outside they, “get more energetic, enthusiastic towards environmental science, and participate more than when I am inside.”

The quantitative data from pre- and post-Likert surveys did not statistically show treatment resulted in students being more interested and comfortable in being outdoors, or that students cared more about issues related to environmental science. However, group interviews showed that the treatment had a positive impact on students’ comfort level being outside, and being outside had a positive impact on their attitudes towards being outdoors. Students frequently contrasted the positive experiences they had learning outdoors in nature to the negative experiences of being inside a traditional classroom. Students also remarked that they enjoyed being outdoors for the aesthetics and calming environment.

Overall, taking students outside had a positive impact on their learning, both in terms of their academic growth and their own reflections of their learning experiences. Based on the positive results from this study, reinforced by the volume of support I detected within the research community, I will continue to take my students outdoors to learn when it is appropriate. It is evident from my own observations that the students enjoyed being outside, but that teaching outside was much more effective during more seasonable weather.  For future activities, I think the key is to be flexible in the planning of the instruction, and have “back-up plans” for when weather does not cooperate. I noticed in particular, on days when it was very cold and windy, students seemed distracted by the elements, and this was a detractor to the learning process.

There is an overwhelming volume of support for experiential learning in science and the outdoors (McDavitt, 1994; Mohan, 2015; Baynes, Gookin, Paisley, Rathunde, Schumann, Sibthorp, 2011). My study showed measurable and statistically significant academic growth within a unit of study that utilized learning outdoors. Also, as cited in AGO (2014), the student comments in the small group interviews conveyed that being outside was calming and put them in a much better mood. This ultimately had a positive impact on their attitudes and willingness to learn.

# VALUE

I have always intuitively believed that teaching about topics related to the environment is more effectively done outdoors in an experiential manner, and participating in this study has afforded me the opportunity to validate this concept. Also, the study motivated me to create an outdoor learning space at my high school. In the past, I had utilized the outdoor areas on our campus to teach when possible, but since none of the areas were specifically designed for outdoor instruction, it was not always as logistically feasible or efficient to incorporate outdoor instruction. With the creation of the outdoor classroom, as a result of this study, I now have a designated location for implementing outdoor instruction. An unanticipated positive result of this study, and the creation of the classroom, was the encouragement of my peers to take their students outdoors to learn. I was especially motivated to see several teachers from other non-science disciplines at my school taking their students outside to utilize the outdoor classroom for instruction. In one instance, an English teacher at my school was able to take his students outside as he read them works from Henry David Thoreau, Ralph Waldo Emerson, and John Muir; which provided a much more authentic and meaningful environment from exemplary authors that wove nature into their writing. Therefore, this study has not only had impact on me and my students, it has encouraged many other educators within my school to incorporate outdoor education into their instructional repertoire.

Going forward, I am interested in finding ways to incorporate outdoor learning throughout other units of instruction during the year. Also, in this study, I focused on instruction exclusively within my Environmental Science classes, but going forward I would like to find ways to incorporate these strategies into my Physics classes as well. I would also like to expand the utility of the outdoor classroom area by adding lab areas, more work space, and creating reading areas so that multiple classes can use the space simultaneously. If this goes well, I would like to find more locations around the campus to teach outdoors. This would allow for a variety of learning environment options while designing instruction, and this would ultimately increase the capacity for multiple classes to be outside utilizing space at the same time. I am also interested in studying the effectiveness of using outdoor education in comparison to traditional classroom instruction. This study was only focused on if the methods worked, but I would like to expand this study to incorporate a more comparative analysis. The research supports this claim, but I would like an opportunity to replicate and expand upon the results of an educational community. As pressures from state testing and state mandates increase, less experiential centered learning is utilized by teachers as they feel a need to teach to these tests in more efficient and teacher-centered approaches. This means that it is even more important to continue to add to the wealth of research that analyzes the effectiveness of outdoor instruction.

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APPENDICES

# APPENDIX A

# MSU INSTITUTIONAL REVIEW BOARD EXEMPTION

# INSTITUTIONAL REVIEW BOARD

**For the Protection of Human Subjects**
**FWA 00000165**

MONTANA STATE UNIVERSITY

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**MEMORANDUM**

**TO:** David Miller Jr. and Eric Brunsell
**FROM:** Mark Quinn *Mark Quinn CJ*
**DATE:** September 28, 2017
**SUBJECT:** *"Determining the Effect of Using Outdoor Instruction on Increasing Students' Academic Achievement and Attitudes Towards the Environment in 9th Grade Environmental Science"* [DM092817-EX]

The above research, described in your submission of September 28, 2017, 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:

_X_ (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.

_X_ (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.

# APPENDIX B

# PRE AND POST INTERVENTION TEST

socrative

Environemental Unit 3 Pretest Score: ______

1. **Which of the following describe the role or function of an organism?**

(A) Responsibility Factor
(B) Niche
(C) Consumer
(D) Trophic Pyramid
(E) Competition Factor

2. **Which option most accurately describes an organism that eats only meat?**

(A) Herbivore
(B) Omnivore
(C) Meativore
(D) Predator
(E) Opportunistic Omnivore
(F) Scavenger
(G) Carnivore
(H) Producer
(I) Host
(J) Parasite

3. **Which option most accurately describes an organism that eats only plants?**

(A) Herbivore
(B) Omnivore
(C) Meativore
(D) Predator
(E) Opportunistic Omnivore
(F) Scavenger
(G) Carnivore
(H) Producer
(I) Host
(J) Parasite

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4. **Which option most accurately describes an organism that only kills its food?**

- (A) Herbivore
- (B) Omnivore
- (C) Meativore
- (D) Predator
- (E) Opportunistic Omnivore
- (F) Scavenger
- (G) Carnivore
- (H) Producer
- (I) Host
- (J) Parasite

5. **Which option most accurately describes an organism that only find its food dead already?**

- (A) Herbivore
- (B) Omnivore
- (C) Meativore
- (D) Predator
- (E) Opportunistic Omnivore
- (F) Scavenger
- (G) Carnivore
- (H) Producer
- (I) Host
- (J) Parasite

**6. Which option most accurately describes an organism that only lives off another living organism?**

- (A) Herbivore
- (B) Omnivore
- (C) Meativore
- (D) Predator
- (E) Opportunistic Omnivore
- (F) Scavenger
- (G) Carnivore
- (H) Producer
- (I) Host
- (J) Parasite

**7. Which option most accurately describes an organism that eats meat and plants?**

- (A) Herbivore
- (B) Omnivore
- (C) Meativore
- (D) Predator
- (E) Opportunistic Omnivore
- (F) Scavenger
- (G) Carnivore
- (H) Producer
- (I) Host
- (J) Parasite

8. Which option most accurately describes an organism such as a coyote or raccoon?

(A) Herbivore
(B) Omnivore
(C) Meativore
(D) Predator
(E) Opportunistic Omnivore
(F) Scavenger
(G) Carnivore
(H) Producer
(I) Host
(J) Parasite

9. Which option most accurately describes an organism that makes energy for the foodweb?

(A) Herbivore
(B) Omnivore
(C) Meativore
(D) Predator
(E) Opportunistic Omnivore
(F) Scavenger
(G) Carnivore
(H) Producer
(I) Host
(J) Parasite

10. Every Primary Consumer is also a...

(A) Plant
(B) Herbivore
(C) Photosynthesizer
(D) Omnivore

11. Every Primary Producer is also a...

(A) Plant only

(B) Herbivore

(C) Photosynthesizer

(D) Omnivore

12. What term describes an organism's placement in the food chain based on how they produce or consume energy?

(A) Niche

(B) Trophic

(C) Photosynthesis

(D) Role

13. As a consumer, you are the most efficient eater, in terms of the energy in an ecosystem, if you are a...

(A) Producer

(B) Primary consumer

(C) Secondary Consumer

(D) Omnivore

(E) Carnivore

14. All __________ species can be hunted recreationally, where species you are paid to hunt have a _________.

(A) bounty, game

(B) game, reward

(C) native, bounty

(D) game, bounty

(E) none

15. A pyramid of biomass is best described as a visual representation of...

(A) The population of each species at each trophic level

(B) The mass of all species at each trophic level

(C) The population of all species at each trophic level

(D) The mass of each species at each trophic level

16. **A pyramid of numbers is best described as a visual representation of...**

(A) The population of each species at each trophic level

(B) The mass of all species at each trophic level

(C) The population of all species at each trophic level

(D) The mass of each species at each trophic level

17. **Approximately ____% of available energy is lost at each upward move on a foodchain.**

(A) 90

(B) 10

(C) 50

(D) 100

(E) 80

18. **What is the term for a species that is needed for the survival of foodweb?**

(A) Tertiary Consumer

(B) Keystone Species

(C) Primary Species

(D) Consumer

19. **Which of the following are primary producers?**

(A) Phytoplankton

(B) Algae

(C) Plants

(D) All are

20. **Which process is required to clean water for consumption?**

(A) Infiltration

(B) Percolation

(C) Runoff

(D) Evaporation

(E) Condensation

(F) Transpiration

21. **Which process is required for water to change to a gas?**

- (A) Infiltration
- (B) Percolation
- (C) Runoff
- (D) Evaporation
- (E) Condensation
- (F) Transpiration
- (G) D and F

22. **Which process results in flooding?**

- (A) Infiltration
- (B) Percolation
- (C) Runoff
- (D) Evaporation
- (E) Condensation
- (F) Transpiration
- (G) Precipitation
- (H) None

23. **Which process results in water entering the ground?**

- (A) Infiltration
- (B) Percolation
- (C) Runoff
- (D) Evaporation
- (E) Condensation
- (F) Transpiration
- (G) Precipitation
- (H) None

24. **Which process makes clouds?**

(A) Infiltration
(B) Percolation
(C) Runoff
(D) Evaporation
(E) Condensation
(F) Transpiration
(G) Precipitation
(H) None

25. **Snow, sleet, hail, and rain all come from what process?**

(A) Infiltration
(B) Percolation
(C) Runoff
(D) Evaporation
(E) Condensation
(F) Transpiration
(G) Precipitation
(H) None

26. **During secondary succession, which is always true?**

(A) The ecosystem starts from scratch, with only bedrock
(B) The ecosystem always has a base of the foodweb to start with
(C) The ecosystem has been reset, and minimally has soil to start
(D) The ecosystem is restarting halfway through development.

27. **During primary succession, which is always true?**

(A) The ecosystem starts from scratch, with only bedrock
(B) The ecosystem always has a base of the foodweb to start with
(C) The ecosystem has been reset, and minimally has soil to start
(D) The ecosystem is restarting halfway through development.

28. **In the Carbon-Oxygen Cycle, $CO_2$ is created from**

(A) Respiration
(B) Photosynthesis
(C) Decomposition
(D) Combustion
(E) All but Photosynthesis

29. **In the Carbon-Oxygen Cycle, $O_2$ is created from**

(A) Respiration
(B) Photosynthesis
(C) Decomposition
(D) Combustion
(E) All but Photosynthesis

30. **What process is contributing to rises in greenhouse gases on Earth?**

(A) Respiration
(B) Photosynthesis
(C) Decomposition
(D) Combustion
(E) All but Photosynthesis

31. **A flood would be an example of...**

(A) Primary Succession
(B) Secondary Succession
(C) Need more information to determine

32. **Growth after a lava flow would be an example of...**

(A) Primary Succession
(B) Secondary Succession
(C) Need more information to determine

33. **Growth after a clear cut logging operation would be an example of...**

(A) Primary Succession
(B) Secondary Succession
(C) Need more information to determine

34. **Through photosynthesis, organisms make…**

- (A) sugar
- (B) O2
- (C) Both
- (D) Neither

35. **Through cellular respiration, organisms make…**

- (A) sugar
- (B) O2
- (C) Both
- (D) Neither

# APPENDIX C

## POST INTERVENTION INTERVIEW QUESTIONS

**Student Interview Questions**

**Directions**: The statements in this interview have to do with your opinions and beliefs about science instruction in school and the importance of science and the outdoors in your life. Please read each statement carefully, and circle the number that best expresses your own feeling.

**Note**: Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1) Do you prefer learning about Environmental Science outside in the outdoor classroom area or indoors in the traditional class? Why?
2) What are some of the positive aspects of learning outside in the outdoor classroom, if any?
3) What are some of the negative aspects of learning outside in the outdoor classroom, if any?
4) Did your time spent learning outside impact your ability to learn in a positive or negative way? Explain.
5) Did your time spent learning outside impact your attitudes towards the outdoors in a positive or negative way? Explain.
6) Is there anything you learned or experienced in the outdoor classroom that would have been more difficult to learn or understand in the traditional classroom?

# APPENDIX D

# PRE INTERVENTION SURVEY QUESTIONS

**Pre-Treatment Questionnaire**

**Directions**: The statements in this survey have to do with your opinions and beliefs about science instruction in school and the importance of science and the outdoors in your life. Please read each statement carefully, and circle the number that best expresses your own feeling.

**Note**: Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. I enjoy spending time outside.
   Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

2. I learn better when I am outside.
   Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

3. I feel personally connected to the outdoors.
   Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

4. I feel comfortable when I am in in the outdoors.
   Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

5. When given a choice, I would choose to go outside instead of doing something inside.
   Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

6. I think about issues related to the environment.
   Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

7. I care about issues related to the environment.
   Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

# APPENDIX E

## POST INTERVENTION SURVEY QUESTIONS

**Post-Treatment Questionnaire**

**Directions**: The statements in this survey have to do with your opinions and beliefs about science instruction in school and the importance of science and the outdoors in your life. Please read each statement carefully, and circle the number that best expresses your own feeling.

**Note**: Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

For questions #1-7, select which statement most represents your response to the question.

1. I enjoy spending time outside.

Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

2. I learn better when I am outside.

Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

3. I feel personally connected to the outdoors.

Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

4. I feel comfortable when I am in in the outdoors.

Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

5. When given a choice, I would choose to go outside instead of doing something inside.

Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

6. I think about issues related to the environment.

Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

7. I care about issues related to the environment.

Never-1 Hardly Ever-2 Sometimes-3 Often-4 All the Time-5

8. What were some challenges to learning outside?

9. What were some advantages to learning outside?

10. How would you describe your overall experience using the outdoor classroom for this unit? Please support your answer with examples if possible.

# APPENDIX F

# STACKED BAR LIKERT DATA CHART

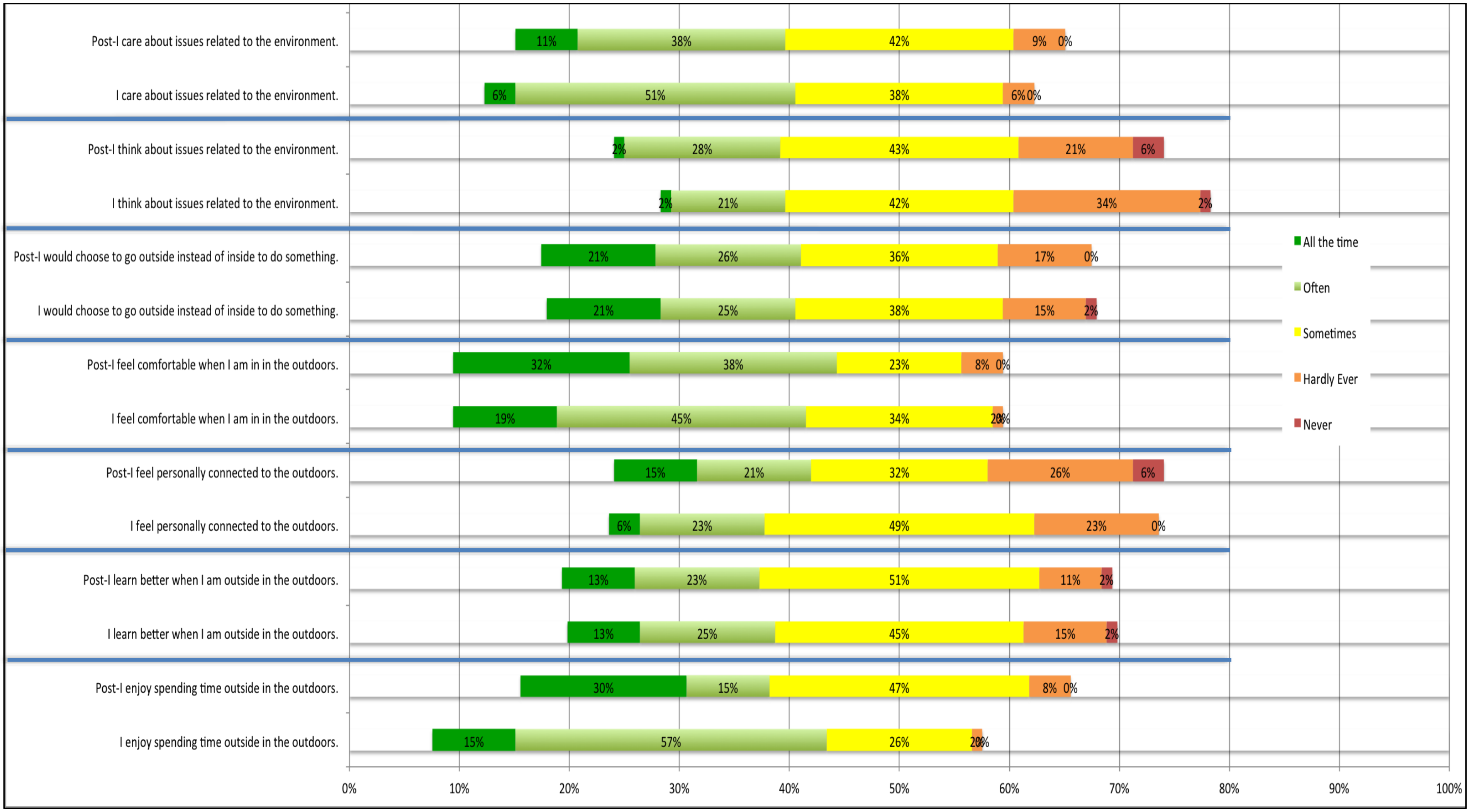


*Figure 2*. Diverging stacked bar scale for pre- and post-treatment Likert scale survey questions ($N = 55$).