THE INCLUSION OF ENVIRONMENTAL EDUCATION IN FORMAL EDUCATION THROUGH THE USE OF EDUCATIONAL TECHNOLOGY, A STUDY OF PROJECT NOAH.

A FIELD PROJECT
SUBMITTED TO THE FACULTY OF THE

UNIVERSITY OF MINNESOTA

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF ENVIRONMENTAL EDUCATION
JULY 2015

THESIS COMMITTEE:

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7/8/2015
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Chapter 1

Introduction

Background

Awareness about the earth’s limited resources is fast growing all over the world and has spurned conversations about environmental education being a catalyst for sustainable living. As human activities lead to apparent climate change, the Earth’s responses are witnessed in various forms (Herbert, 2008). Environmental Education (EE) is now considered to be the most prominent instrument to influence human behavior towards more environmentally sustainable patterns‘ (Nicolae, 2005). Thus, according to Nicolae, there has been success in the past regarding the connection people have with the environment and for sustainable living through Environmental Education. This fact becomes even more apparent when Herbert’s statement about the depleting resources of the earth is put into consideration. There needs to be more research into ways by which the population can be drawn to sustainability and environmental issues. Environmental Education however has a short history which begins as far back as the 1762, when _Emile_ (translated _On Education_) was published.

From the era of the first publication about the environment by Jean Jacques Rousseau in his book _Emile_ till recent times, Environmental Education has evolved tremendously in the way it is taught. While events such as the first Earth Day in 1970 created the needed awareness about the environment, teaching about this subject area was more passive than focused on a deliberate approach (Dunagan, 2010). In the United States, Acts such as the _National Environmental Education Act of 1990_ have helped catalyze the need to convey the message of environmental sustainability and awareness about our environment (National Environmental
Education Act, 1990). Today, many years after, new teaching trends are emerging in the teaching of Environmental Education in schools and even in the, non-formal and informal settings.

A component of this trend of increased technology use in the educational setting is the incorporation of educational technology as a tool for teaching and learning. It is a fact that the world is now a global digital world. As a result, technical know-how and mastery of technological skills is essential for students (Weigel, James, & Gardner, 2009). New Digital Media (NDM) – Interactive and internet-enabled technologies such as personal computers, mobile phones, game consoles, and the virtual spaces afforded by them – (Weigel, James, & Gardner, 2009). NDM affords nearly permeating access to people as well as affording new forms of sociality, play, creativity, social activism, networking, and collaboration (Weigel, James, & Gardner, 2009). The use of electronic media and technology endears participation from students in the formal classroom (Dunleavy, Dede, & Mitchell, 2009).

In an article entitled “Saving Bats, One Cellphone at a Time”, Sara Melena, states that, in an effort to protect bats from the White-Nose Syndrome the National Park Service is looking to educational technology to help (Melena, 2013). Sara Melena states in her article that mobile phone software has been created to serve as a teaching tool to teach visitors through educational and interpretive products that are in the form of movies about the white-nose syndrome in bats (Melena, 2013). The article however raises some interesting questions. How is feedback assessed in a way that informs the programs coordinators of its success or failure?

Student learning outcomes are a primary measure of any major educational program. They are defined as: “Statements that specify what students will know, be able to do or be able to demonstrate when they have completed or participated in a program/activity/course/project. Outcomes are usually expressed as knowledge, skills, attitudes or values” (Scagliola, 2007).
Thus, it is clear that regardless of the structure of a lesson, outcomes are a strong determinant to their ultimate success or failure.

**Purpose Statement**

The purpose of this survey research is to find out the effect of the use of technological tools in the teaching of lessons in Environmental Education in the formal classroom. This study will use the example of *Project Noah* and will examine the learning outcomes of students by collecting quantitative data and assessing attitudes towards nature and the environment using open ended questions. *Project Noah is a tool to explore and document wildlife and a platform to harness the power of citizen scientists everywhere* (Project Noah, 2013). Project Noah seeks to go beyond the ordinary structure where web administrators provide all data and information to the *crowdsourcing* model where users are responsible for data that is provided.

**Research Questions**

1. What is the effect of technology on learning outcomes of students in a tree ID class project versus that of a control group?
2. How does the inclusion of technology influence students' participation and interest in nature?
3. What are the changes in attitudes towards the environment for 5th grade students who used technology as a tool versus those who did not?

**Definition of Terms**

The following section defines how key terms will be used in this study. The terms are defined using the process for specification of concepts outlined in Babbie (2011) and Creswell
(2009). A nominal definition for each term is provided, and when relevant, an operational definition that specifies how the concept will be measured is also provided.

**Environmental Education:** UNESCO adopted a new world definition in 1978. This definition provides the most contemporary definition of the term environmental education. It states that “Environmental Education aims to develop a world population that has the knowledge, attitudes, skills, motivation and commitment to work individually and collectively toward the solutions of current problems and the prevention of new ones” (UNESCO-UNEP, 1978).

**Educational Technology:** The term educational technology is a field concerned with the design, development, utilization, management, and evaluation of processes and resources for learning (Luppicini, 2005). Furthermore, Januszewski and Molenda define educational technology as the study and ethical practice of assisting learning and improving performance by creating, using, and managing appropriate processes and resources (Januszewski & Molenda, 2008).

**Operational definition - Educational Technology**

Deducing from these two definitions and for the purpose of this paper, educational technology is a field concerned with the ethical practice of designing, developing, utilizing, managing and evaluating processes and resources for teaching and learning with an ultimate focus of improving performance.

**Learning Outcomes**

A learning outcome outlines knowledge that a learner is expected to have, understand and be able to apply as the result of a process of learning (Office of the Qualifications and Examinations Regulator, 2008).
Learning outcomes can also be defined as statements that outline knowledge, skills or attitudes that a student is expected to have and apply effectively after an activity or program or course (Division of Student Affairs and Academic Services, 2009).

Learning outcomes must be achievable, observable, and measurable (Questionnaires, Knowledge Surveys, Portfolios etc.) and should answer the question of what the student learnt and how we know what the student has learnt (Division of Student Affairs and Academic Services, 2009).

**Software Application**: Software applications, also known as software applications are defined as programs that perform specific tasks for users. Categories of application software include educational software that plays the role of facilitating education (Cashman, 2003).

**Crowdsourcing**: Crowdsourcing is the practice of obtaining needed services, ideas, or content by lobbying contributions from a large group of people and especially from the online community rather than from traditional employees or suppliers (Merriam-Webster, 2013)

**Smartphone**: A smartphone is defined as a cellular phone that is able to execute many of the tasks of a computer, typically having a relatively large screen and an operating system capable of running general-purpose applications (Google, 2013).

**Web Application**: A web application is an application based in a web browser that has the following features:

- *Each user has a session-based relationship. That means the application is somehow aware of who you are and loads a specific set of variables for your interface.*
- *Each user has a unique interface and session.*
- *Users can permanently create, store and change data.* (Investintech, n.d.)
Citizen Science

Citizen Science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources ("SOCIENTIZE Consortium", 2013).

Operational Definition - Citizen Science

Citizen science refers to the process whereby users submit pictures, video and questions to a web application to provide a resource for others to learn about ecology and their environment as a whole.

Limitations

1. Sample size: The selected sample size cannot adequately represent the entire population of users. Results will not be generalized beyond reasonable scope.
2. Self-reported data: Self-reported data is limited by the fact that information received can be rarely independently verified.

Basic Assumptions

1. The Project Noah is assumed to be a legitimate tool for formal educational learning.
2. Project Noah is assumed to meet appropriate educational standards in the State of Minnesota.

Significance

The significance of this study draws from the immense importance of student learning outcomes and if they are improved with the use of technological tools. The ability to adequately improve outcomes can provide good feedback for educators and also create the possibility of the
introduction of more Educational Technology. Teachers in the Environmental Education field should find this paper useful because it will help frame future programs that seek to introduce technological tools into lessons for the formal setting. The inclusion of technology and technological components such as computers, IPads and smartphones in informal learning environments are becoming increasingly prevalent (Sung, Chang, Lee, & Yu, 2008). Although technology is being used to enhance learning, it is not well known the extent that technology actually improves learning outcomes for students.
Chapter 2

Literature Review

Introduction

This chapter will review existing research in the field of educational technology and its contribution to the teaching of environmental education in the formal classroom. The formal classroom (k -12) in this context refers to a set of intact groups of individuals who are fairly homogenous in terms of age and experience and have been assembled for the purpose of learning. It is crucial to harness interest in nature and science when children are at the elementary level of cognitive and attitudinal development. Related research in this topic will expand the focus on why Environmental Education provides an opportunity to endear affection and interest towards the environment at the early stages of growth. Then, citizen science, its impact on the growth of science education and environmental education, and how it is helping generate more interest in nature related activities will be elaborated. The study will subsequently delve into Project Noah (Networked Organisms and Habitat) and throw more light on the current implementation of the project and what role it will play in the study of perceptions of teachers/administrators of the project, and the effect using Project Noah has when used in the teaching of environmental education/science lessons. Finally, this chapter will review previous research which analyzes perceived versus measured outcomes of teaching EE in the formal classroom with the use of Educational Technology.

A question this study seeks to answer is what role technology plays in the teaching of environmental education in the formal educational setting. This focused discussion will potentially serve as a source of knowledge to teachers interested in introducing more technology
into teaching these subject areas. Part of the motivation stems from the sparse literature on the subject of teaching environmental education in the classroom through technology. For instance, a search for ‘environmental education’, ‘classroom’ and ‘citizen science’ returned one result. A search for ‘environmental education’, ‘citizen science’ and ‘technology’ in May 2014 returned two responses. Both searches were within the range of 2003 to 2012. However, a search of ‘citizen science’ and ‘environmental education’ returned eight results. When compared with other areas, current research focused primarily on environmental education, citizen science and technology returns considerably less published research. This result serves as an indication of the need for more research into the interactive effects of all three phenomena and how including technology in the teaching of environmental education through citizen science affects learning in formal education. To reinforce this study it is important to discuss Environmental Education and how it ties into the framework of current research.

Environmental Education

To gain a better understanding of the field of Environmental Education in the Republic of Georgia on October 14-26, 1977, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in cooperation with the United Nations Environment Program held an Intergovernmental Conference on Environmental Education in Tsiblisi (McCrea, 2005). This conference birthed the Tsiblisi Declaration. The Tsiblisi Declaration states among other things by way of recommendations that;

- A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic, and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective
way in anticipating and solving environmental problems, and in the management of the quality of the environment”

(United Nations Educational, Scientific and Cultural Organization (UNESCO); United Nations Educational Program (UNEP), 1977, pp. 13-16).

The Tsiblisi declaration is one that Environmental Educators describe or refer to in numerous research projects and as part of general dialogue in the community. Shifting focus to the present-day would reveal a plethora of fronts where Environmental Education is making inroads in our everyday lives. An example of area of great interest is in the formal education sector. A paper by Jacobson, McDuff, & Monroe (2007) outlines six techniques to connect real world issues to conservation education. Conservation education is considered as a way to educate the earth’s population about natural resources and ways to conserve these resources as namely through service-learning, Issue Investigation, Project Based Learning, Community Based Research, Mapping and Citizen Science (United States Department of Agriculture, 2014). Such a study eschews the potential that Environmental Education possesses in the current state of affairs in how our society operates socially, economically and most importantly environmentally.

**Environmental Attitudes**

Environmental attitude is defined by Newhouse as “an enduring positive or negative feeling about some person, object or issue” (Newhouse, 1990). According to Newhouse, conservationists trained in the natural sciences have focused their attention on finding biological and technological solutions to the environmental crisis that inundates our natural environment. Newhouse describes the focus on biological research on life histories, habitat requirements, and minimum viable populations to have greatly benefitted the environment due to the immensely valuable information that has been discovered as a result. Technology has also played a key
central role in averting an environmental crisis (Newhouse, 1990). However, Maloney and Ward described the ecological crisis as more than a technical problem. They describe it as a rooted in human behavior (as cited in Newhouse, 1990). This lays the foundation for environmental education as a tool and a means to encouraging and influencing change in human behavior towards the environment. According to Kostka (1990), it is true that some forms of environmental education can have negative effects on the formation of positive attitudes toward the environment (as cited in Newhouse, 1990).

However research has also showed getting engaged in the outdoors has positive effects on attitudes towards the environment (Boyce, Mishra, Halverson1, & Thomas, 2014). This means that everything has to be done to provide the exposure to nature and the environment as an initial step to fostering positive environmental attitudes especially at the early age for children. Development of interest toward science starts at an early age and can be harnessed by exposing them to science activities while they are at that stage (Eschach, 2006). Thus, the necessity of involvement if children in nature is evident and cannot be emphasized enough. One way through which children are being engaged is through citizen science.

Citizen Science

Citizen science, also known as crowd sourced science” (Toerpe, 2013) — or, more formally, public participation in scientific research” (Toerpe, 2013) refers to the systematic collection and analysis of data (Open Scientist, 2011). Citizen science is a trending phenomenon in our world today that is constantly gaining popularity but is hardly new. According to Jeffrey P. Cohn, the practice of working with citizen scientists goes back at least to the National Audubon Society’s annual Christmas bird count which began in 1900 and had about 60,000 to 80,000 volunteers participating (Cohn, 2008). Today, citizen scientists are involved on
a much larger geographical scale and provide data with the use of much more sophisticated equipment for monitoring elements such as air and water quality (Cohn, 2008).

There are many benefits to citizen science. The popularity of citizen science has gone a long way to provide the man-power needed by organizations requiring large amounts of research data (Bird Life International, 2008). Also, the involvement of citizen participants in projects such as directly monitoring and active management of residential lands help inform cumulative decision making by an involved community which leads to measurable impacts in areas such as biodiversity (Cooper, Dickinson, Phillips, & Bonney, 2007).

Many have asked the question of whether citizen scientists do real research. This question is posed possibly because of the potential lack of knowledge and skill that is needed to do effective and efficient research in any field. However, according to Janis L. Dickinson, Benjamin Zuckerberg and David N. Bonter, citizen science is best viewed as complementary to more localized, hypothesis-driven research. This means that researchers are employing the efforts of citizen scientists for data collection and analysis and the development of technology and the testing of natural phenomena (Dickinson, Bonter, & Zuckerberg, 2010).

What is the perceived benefit of citizen science to the volunteer, and what factors turn a citizen into a scientist? These questions should be asked because, in addition to proving beneficial to the umbrella body, individual, or agency conducting the research, there is also great personal benefit. Notable among these benefits is the increase in scientific knowledge of citizen scientists. One example of this is a technology-based program called Project Noah, which stands for “Networked Organisms and Habitats” (Project Noah, 2013). Project Noah is a platform that can be described as a database to store images and videos which can be viewed by other members of the platform. In this study, study participants will be referred to as citizen scientists.
Further into this literature review, more information will be provided on the philosophy of Project Noah and its stated objectives to facilitate wonderment and more essentially provide knowledge to participants who are willing to learn (Project Noah, 2013). Citizen science has been shown to have positive effects on both students and the greater scientific community. Many programs that are adopting citizen science in the 21st century, such as Project Noah, are turning to technology to help accomplish their goals. In order to understand this phenomenon, the following section will address educational technology.

**Educational Technology**

Educational technology is defined in the previous chapter of this paper as a field concerned with the practice of designing, developing, utilizing, managing and evaluating technological resources for teaching and learning with an ultimate focus of improving performance (Januszewski & Molenda, Educational Technology - A Difference with Commentary, 2008). Technology used in the classroom can be categorized into hardware and software. Hardware refers to physical technology that can be seen and touched and software refers to programs running on these hardware elements that are not physical and cannot be touched. Technology has become more than a luxury in teaching subjects such as science (Bull & Bell, n.d.). It will be important to explore what kinds of technology are available and ways in which such technology is being implemented with relation to science in the formal classroom.

Examples of hardware used in teaching with technology include computers and devices such as desktop computers, laptops, tablet computers (e.g. Apple iPad), Geo Caching devices, Smart Boards, Projectors and so forth. These hardware devices run varying software which create the opportunity for instructors to apply multiple uses to certain compatible hardware.
A very popular way teachers are using software in teaching is through the use of online blogs. Sawmiller (2010) describes an online blog as a tailored web-based platform that serves as a database of entries that may include rich content delivered through text, videos and/or pictures. Blogs also allow for collaboration and personalization of learning. Examples of web blog platforms include Google blogs, Weebly, Postagon, Svbtle, Ghost, Wardrobe, Postach.io, Medium, Jekyll, Anchor and Bolt among many others (Smith, 2014). These sites vary in cost-per month-subscriptions ranging from free for basic features to as high as $80 per month. The determining factors for selecting and creating blogs for classroom purposes range from cost to the design focus of the blog; blogs could be more writing focused or more media focused based on teacher’s lesson objectives (Smith, 2014).

**Overview of Project Noah**

At the core of this study is the use of Project Noah. Project Networked Organism and Habitat (Project Noah) is described by its creators as a software platform that has been created to help connect people to the natural world (Project Noah, 2013). The project started on the New York University Campus in the Interactive Telecommunications Program in 2010, the core of Project Noah began as a project to facilitate the building of a virtual ‘butterfly net’ that will seek to document all the world’s organisms through the efforts of citizen scientists all over the world. Labelled as mankind’s effort to preserve nature’s global biodiversity, Project Noah has, since its inception, garnered a strong following of large organizations such as National Geographic, one of the largest nonprofit scientific and educational institution in the world (National Geographic, 2014).

In a British Broadcasting Corporation (BBC) article published in 2011, the head of Project Noah reiterated to the BBC that Project Noah has helped people learn about organisms
they never knew existed and we've brought awareness to important work and research" (Davies, 2011). Also, in addition teaching people about the formerly unknown species, Project Noah is helping provide critical data such as time-stamped and geographically tagged photographs to the site. Essential data is then linked to existing surveys such as the International Spider Survey and the Global Coral Reef Monitoring Network (Davies, 2011). The end-goal of Project Noah is to use collected data in ways that improve research and result in research breakthroughs.

Project Noah’s platform implementation is exhaustive and thus can be accessed through many channels. Project Noah is available on the Internet at the URL: https://www.projectNoah.org. It is also accessible on the major mobile platforms, namely the Apple’s App Store and Google’s Play Store. These two virtual software application stores together give access to billions of people (Hughes, 2013). In addition to being available on mobile devices and at projectNoah.org, Project Noah also has a very active Facebook fan page with hundreds of thousands of followers. For the purposes of this study the website will be used in conjunction with the available IPad application depending on availability of respective device. The Tablet versions will be used depending on availability of such devices during testing and data collection.

In Figure 1 displayed below is a snapshot of the home page of the Project Noah website. At the top menu bar of the page, users are directed to select an area of interest. In addition to the _Home_ button, there are the _Organisms_, _Blog_, _Missions_ and the _Education_ pages. In all of these pages are different possibilities and options for activities on the site. In the second label are the different plant and animal classifications per trending hit on the site. Thus, under each icon link there are images of top hits for plants and basic information about this plant and its respective significance.
Figure 1. Project Noah website homepage showing the main pages at the top, the different plan and animal classifications, a link to the survey page where research contributions can be made and the activity feed where new spotting are posted and displayed.

The main components of this platform have a focus of allowing for easy uploading of media such as images and video that can then be observed by users of the site. All users need to create profiles to be able to take use the site. Prospective users may use already subscribed accounts. These methods include a Google, Facebook, Twitter, Yahoo and Windows account if available (Project Noah, 2013). Once a user in successfully signed in, he or she may start uploading pictures or video of any living thing that falls into the ‘Plant’, ‘Mammal’, ‘Bird’, ‘Arthropods’, ‘Fungi’, ‘Reptiles’, ‘Amphibians’, ‘Fish’, ‘Pets’ and the ‘other’ classifications (Project Noah, 2013). These classifications enable for a more filtered experience and also helps channel data of spotted living organisms into different missions that are already existing or newly created. Missions on Project Noah are a novel way of allowing any classroom, individual, or small group anywhere in the world to create a Project Noah mission that is very much personalized and local in nature (Project Noah, 2013) as seen in below in Figure 2.
The SAMR Model

It is clear that making the most of technology in classrooms will be a possibility if the process of adopting such methods are backed by guidelines and theories vested in research and literature. An example of a model that serves this purpose is the Substitution Augmentation Modification Redefinition model, also known as the SAMR model. The SAMR model was developed by Ruben R. Puentedera in 2009 to serve as a way to select, use and evaluate technology in education. The SAMR model, as displayed in Figure 3 below, consists of four levels divided into two sections. The first section at the base of the diagram refers to Substitution and Augmentation, which points to two essential factors to consider when attempting to
understand the impact of technology on teaching and learning in the classroom (Google Sites, n.d.).

![SAMR Model Diagram](image)

Figure 3: SAMR Model diagram depicting the two levels and four stages of the model. Namely, the Substitution, Augmentation, Modification, and Redefinition (Google Sites, n.d.)

Substitution can be described as using a different method to do a similar task. An example of this is handing out printed assignments as opposed to having students physically write out assignments. Augmentation describes the use of technology in a way that causes a functional change in how projects are completed. An example of this is using Google Hangouts for teaching classes or using collaborative tools such as Google docs where multiple students can work on a single project together rather than work individually before merging work (Google Sites, n.d.). In essence, computers function as a tool that assists in the performance of a task that could have been done otherwise. Substitution and Augmentation play the role of enhancing the teaching and learning process but do not necessarily cause any transformation. In other words, they provide an arguably more efficient way to complete traditional tasks associated with teaching and learning (Google Sites, n.d.).
Under the Transformation stage are the Modification and Redefinition levels of the SAMR model. The Modification level is the first that involves adding ‘richness’ to traditional teaching methods. An example is adding audio recording and video to a paper about raptors or American National Park history. The traditional way to have such an assignment done is a regular handwritten essay. The functional changes are thus obvious. Through Modification, educational technology facilitates the addition of content that would not have been possible otherwise.

The highest level of the SAMR model is the Redefinition level. At the Redefinition level, educational technology makes it possible to perform new tasks for teaching and learning that was previously impossible. An example of this is creating a video documentary on invasive species by assigning different aspects to different members in a team and, later on, editing completed bits into a final cut (Google Sites, n.d.). Tasks like this put educational technology at the forefront of teaching and learning, repositioning educational technology not as an end but a support tool for student-centered learning. The SAMR model is important because it serves as a useful guide to adapt educational technology into traditional teaching methods already practiced by schools and instructors.

**Educational Standards**

Another area of concern for instructors and education departments is in the area of educational standards. Educational Standards serve as a basis of educational reform across the nation as educators and policy makers respond to the call for a clear definition of desired outcomes of schooling and a way to measure student success in terms of these outcomes (National Council for Social Studies, 1994). The Minnesota Academic Standards in Science outline statements of content and serve as an outline of written learning outcomes of what the
student is expected to understand in the subject matter (Minnesota Department of Education, 2009). This information is part of this study to illustrate the fundamental relationships that should exist where, regardless of teaching style and content. When deciding which programs to adopt in their classrooms, teachers must consider state and federal education standards.

Project Noah’s website states that it seeks to create an easy-to-use way of allowing participants to view and share their experiences with wildlife and nature. It is also stated that using Project Noah will not only connect students with nature, but also provide them with real opportunities to make a difference (Project Noah, 2013). In accordance with these objectives, it is important for instructors to find out if such objectives line up with their educational standards and are appropriate for their grade level.

A review of the 2009 Academic standards for Minnesota shows that the best fit for this program will be in the 5th grade. As part of academic standards for the 5th grade, the Life Science section 5.4.1.1.1 and 5.4.2.1.1 outlines a few objectives, among them learning about the diversity of living things and their many characteristics and learning about natural systems and how many have to communicate to constitute a living system. Also, 5th grade is when a person begins to develop abstract thought which can allow them to transfer the course material to their everyday lives (Wadsworth, 2004).

Implementation of Educational Technology in Formal Education

Ever since the turn of the dot.com age, educational technology has seen great strides in its adoption in the formal classroom (Gray, Thomas, & Lewis, 2010). However, is there ample evidence to prove this phenomena? The National Center for Education Statistics, the Institute of Education Sciences, and the U.S. Department of Education in 2009 study measured the extent of teachers’ use of Educational Technology in U.S. public schools (Gray, Thomas, & Lewis, 2010).
As part of this study, 4,133 teachers responded to questions about technology use, kinds of technology used in classrooms, access to computer applications and communication with parents and students using technology. The study ranged over the fall of 2009 and spring of 2010 (Gray, Thomas, & Lewis, 2010). As part of the findings on teachers’ use of educational technology the researchers found out that about 35 percent of teachers reported they or their students used computers in the classroom during instructional time. Also, 94 percent participating teachers stated that they used the internet for instructional or administrative processes (Gray, Thomas, & Lewis, 2010).

As a foundation for this study, it is clear from literature that teaching with web-based platforms already exists heavily in the formal school spectrum. A lot of today’s knowledge about our natural environment, including its effect on issues like climate change, is derived from data that has been collected, transcribed and/or processed by members of the public (Bonney, Shirk, Phillips, Wiggins, & Ballard, 2014). Improvement of technology and technological resources has contributed immensely to project visibility, functionality, and accessibility (Bonney et al., 2014). People interested in finding information about a certain phenomenon can easily do so with the help of the internet. The internet, as a technology, provides a service that cannot be overlooked. Due the necessity and relevance of technology, there has been a strong push by communities and school boards in the United States and all over the world to use more technology as a tool to improve learning and make the learning process more collaborative. An essential player in this drive is the instructor. There has always been a need to make updated technology available and more importantly, provide the training to help instructors acquire the necessary skills.

In May 2008, the National Educational Association published a study about access, adequacy and equity in education technology, which resulted in 22 findings. These findings,
namely results from surveying America’s teachers and support professionals on technology in public school classrooms, bordered on umbrella issues such as technology access, technology training and effectiveness, technology usage, educator’s perceptions of technology, school locations and the role of teacher unions (National Education Association, 2008). One major finding of the study shows that most educators expressed optimism about the impact of technology as a teaching tool and for personal professional development (National Education Association, 2008). They also found that instructors consider the inclusion of technology as a factor for increasing motivation for learning in the classes they teach. According to the research, the foundation for growth has been set. It is time for education systems all over the world to forge ahead to the next stage of educational technology. Per the research, this has shown to foster an increase in participation which in turn results in higher scores in standardized testing.

Summary

It is clear that the use of educational technology in the classroom is on the rise (Weigel, James, & Gardner, 2009). There is a lot of research already addressing this subject matter, however, there is not a whole lot that directly covers incorporating environmental education. Some research tackles getting students more involved outside using technology and as way to stimulate engagement (Boyce, Mishra, Halverson1, & Thomas, 2014). Other examples use remote cameras and schoolyard science as a way to empower action (inspire a change to positive attitudes towards nature and the environment) towards nature (Tanner & Ernst, 2013). However the purpose of this study is to find out the effect of the use of technological tools in the teaching of lessons in Environmental Education in the formal classroom. Chapter three will describe the methodology used for this study, and will discuss how the study will be implemented and thus
shed more light on what effect the inclusion of environmental education exists in formal education through educational technology.
Chapter 3

Methods

Introduction

The purpose of this paper is to study science learning outcomes and science educational impacts associated with Project Noah, a web and smartphone based crowdsourcing application that serves as “a tool to explore and document wildlife and a platform to harness the power of citizen scientists everywhere” (Project Noah, 2013). The participants in this study will be fifth-grade elementary school students located in the Two Harbors school district. The intended audience of the study includes elementary school students in the formal education sector. The primary objective of this study is to assess the perceived learning outcomes of target participants and provide a comparison between the expected outcomes of attitudes and knowledge in science education and comparing results with a control group to assess a change in the chosen variables to be observed when environmental education is included in formal education through the use of educational technology.

Study Design

The design of this study was a quasi-experimental pre-test post-test cross-sectional design. The survey design relies primarily on the collection of quantitative data and allows for a quantitative perspective to happening trends, opinions or changing attitudes of a population by studying a sample of that population (Creswell, 2009). With the inclusion of a study treatment and non-treatment groups, an opportunity is created to find out what effects belie that specific treatment or not. Results from such experiments can then be either generalized to the population or contained within a very limited scope of the sample’s target audience. The reason for this design method being used versus a more qualitative approach was because, as compared to other
designs such as the qualitative research design, the survey method allowed for quantitative data collection which aligns with the theory in human behavior which says that cognition and behavior are highly predictable and explainable (Creswell, 2009). This theory is based on the determinism theory, which states that all events are determined by one or more causal elements (Salmon, 1984).

The full design of the study was a pre-test post-test cross-sectional design. The cross-sectional method was used since data was collected over a period of time of 6 weeks (Creswell, 2009). Data was collected through self-administered questionnaires, including a knowledge test and a survey measuring changes in student attitudes toward tree identification. The Self-administered questionnaires were used to obtain data from the student participants before and after treatment periods for the treatment and non-treatment groups. Data collected through this instrument tracked attitude changes and assessed the student's opinions about trees. Teachers were also interviewed individually on their experiences throughout the treatment period, although because the sample size is small this data was considered anecdotal to that collected from the students in both groups.

**Population and Sample**

The target participants in this study were students in the fifth grade at the North Shore Community School, located near Two Harbors, Minnesota and fifth grade students at Homecroft Elementary School. North Shore Community School was selected because it is an environmental education themed charter school and a U. S. Department of Education Green Ribbon Award recipient. The school is located in the Two Harbors, Minnesota school district. Charter schools are public schools that encourage innovation related to delivery of programs, management of school resources and require a high level of accountability for student achievement. It is tuition
free and funded on a per-pupil basis with state education funds (North Shore Community School, n.d.). In addition to being a charter school, North Shore has also made good progress in developing a technology program for the school per the Minnesota Department of Education Technology Plan Guidelines (Minnesota Department of Education, 2013).

Homecroft Elementary School was selected due to its location in the Duluth area (Independent School District 709) and the availability of a school forest. The school has in recent times received funding to set up outdoor classroom adjacent to the school where “youth and the school will receive hands-on learning about wildlife ecology, conservation and biology within a natural environment” (Homecroft Elementary School, 2015).

The sample of the study included three fifth grade classes. Each class included approximately 20 students. Since the lessons were scheduled as a normal part of the students’ school day, no parental permissions were required. Participants of the treatment phase of this study was subscribed as members to the Project Noah web application. The student participants were students in their natural classroom setting and participated in this study during normal class periods.

Teachers teaching students with the help of Project Noah also registered through Project Noah as Noah participants. There was no fee for this. Under the education tab of Project Noah, there is a new feature labeled “For Teachers” that makes it possible for teachers to teach and evaluate students more efficiently. Students can be evaluated individually per contributions and submissions to the website. Submissions were in the form of pictures and descriptions of the uploaded pictures.
**Instrumentation**

The instrument to be used in this study was developed for this study. The sections of the instrument tested for Knowledge, Attitudes and Interest in Science. Per the projects’ parameters, students’ knowledge about trees and the different species was tested by way of a tree identification assessment. Students were guided through a process of creating a self-guided tour outside that was based on the trees in the forest located behind the schools’ grounds. Since this was a learning process, students were pre-tested to ensure that the control and treatments groups were equal in knowledge prior to the start of the treatment. The survey was used to assess attitudes and interests as a way of finding out how those attributes were affected in the 5th grade students of North Shore Community School who participated in Project Noah.

**Validity and Reliability**

Validity for this instrument was determined. The instrument was field tested before administration on actual study participants. Validity was based on expertise recommendations that were made as a result of the field test will be vetted and included per adequacy and usefulness of the requested changes.

**Data Collection Procedures**

The surveys were administered by the teacher of the lesson. One teacher, who is the environmental education specialist at the school, taught the lessons to all the classes. The North Shore Community School has an Environmental Education Coordinator who plays the role of dispensing knowledge in Environmental Education by teaching classes during the normal class periods at North Shore Community School.
Before the start of the data collection period, the Environmental Education coordinator was trained on how to use Project Noah. The steps involved were:

1. How to subscribe to Project Noah
2. How to create a virtual classroom
3. How to create a mission for your classroom
4. How to give and collate assignments
5. How to contribute to the knowledge on Project Noah.

After this was done, the teacher was also trained on the use of the instruments. Guidelines were given to prevent errors from occurring and also ensuring that the previously stated design was adhered to. Students in the treatment group and control group took the self-administered survey and knowledge test before and after the project per the design of the project.

**Data Analysis**

Descriptive and comparative data analysis was performed on collected data. This was done with the use of SPSS software (Arizona State University, 2014). Independent and paired comparisons were created and assessed for a change between the pretest and post-test of the treatment and control groups. This stage of analysis focused on the 11-question Tree ID test which was part of the pretest and post-test of the questionnaire used in the study (Appendix C). For the second portion of the instrument, similar tests were completed to assess a change, if any, between the pretest and post-test of the treatment and control groups.
Chapter 4

Results

The purpose of this study was to find out how the inclusion of technology influences student’s participation and interest in nature. To assess the effect of technology on learning outcomes of students in a Tree ID class project versus that of a control group. Last, this study sought to find the changes in attitudes towards the environment for 5th grade students who used an internet-based environmental education program as a tool to enhance learning about nature through a tree identification unit of lessons. This chapter will seek to align results from the questionnaires used to measure the influence, if any, from the use of the internet-based program, called “Project Noah”. Data was collected from two schools. These were the North Shore Community School (NSCS) and the Homecroft Elementary School (HES). The Homecroft Elementary School was selected and used as control to provide a greater difference that could be caused by confounding variables of having both the treatment and control from the same school which is an environmental education charter school. Homecroft Elementary School (HES) was chosen because of similar demographics in SES of students and also has a school forest as does the North Shore Community School. Following are the results of data analysis.

Demographics

Table 1: Frequency of Respondents

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Post-test</th>
<th>Total Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Group</td>
<td>20</td>
<td>21</td>
<td>41</td>
</tr>
<tr>
<td>Control Group (NSCS + HES)</td>
<td>19</td>
<td>(27+ 20) 47*</td>
<td>66</td>
</tr>
<tr>
<td>Total Responses</td>
<td>39</td>
<td>67</td>
<td>107</td>
</tr>
</tbody>
</table>

*A sum of HES and NSCS control group
As stated in the table above, there were three samples. Of the three (3) sample groups (Treatment = 1 5th grade class at the NSCS plus two control classes: NSCS & HES groups) there were 20 participants in the treatment group pretest and post-test at NSCS. There were 27 (57%) participants in the HES sampling group. All groups were selected as a result of their convenience.

**Analysis of Scores**

RQ 1: What is the effect of technology on learning outcomes of students in a tree ID class project versus that of a control group?

As shown in table 2, the highest score recorded was 11 out of 11 correct answers and the lowest was zero. The highest score from Homecroft Elementary School was 6 out of 11. The range of mean scores was (2.48 -5.70). The mean score was specifically chosen over the median because of the finite limit of the scores from the test in the survey instrument. The mean and standard deviation were calculated for all the recorded scores from the (5) groups (see figure 4). Once again, the mean and standard deviation recorded for Homecroft Elementary School were low and carried some statistical significance, which will be discussed further in Chapter 5.

**Table 2:**
**Descriptive Statistics - Scores**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Treatment Score</td>
<td>20</td>
<td>.00</td>
<td>11.00</td>
<td>4.15</td>
<td>3.26</td>
</tr>
<tr>
<td>Pretest Control Score</td>
<td>19</td>
<td>2.00</td>
<td>11.00</td>
<td>5.21</td>
<td>2.12</td>
</tr>
<tr>
<td>Post-test Control Score</td>
<td>20</td>
<td>.00</td>
<td>11.00</td>
<td>5.70</td>
<td>2.51</td>
</tr>
<tr>
<td>Post-test Treatment Score</td>
<td>21</td>
<td>.00</td>
<td>11.00</td>
<td>4.42</td>
<td>3.29</td>
</tr>
<tr>
<td>Homecroft Elementary</td>
<td>27</td>
<td>.00</td>
<td>6.00</td>
<td>2.48</td>
<td>1.64</td>
</tr>
</tbody>
</table>

*(Note: Score Range = 0-11)*
Figure 4: Knowledge scores: standard deviation vs. mean scores

For further analysis of scores to find the effect of technology on learning outcomes, the table below shows a paired and independent sample t-test for test scores for the three classes. These results are displayed in two tables. The first table indicates the results of the paired sample and the second the independent sample tests. The single sample Independent t-tests analyze results between samples with a relationship whereas the paired-sample test analyses a relationship between the treatment group and the control group, which have no relationship. Below are the knowledge tests.

**Paired Sample t-Tests:**

- Pre-test Treatment Score – Post-test Treatment Score
- Pre-test Control Score – Post-test Control Score

**Independent Sample Tests:**

- Pretest Control Score – Pretest Treatment Score
- Post-test Treatment Score – Post-test Control Score
• Pretest Treatment Score – Post-test Homecroft
• Post-test Treatment Score – Post-test Homecroft

**Paired Sample T-Tests**

Upon further analysis, the findings show that the difference was not because of the influence of Project Noah. Table 3 below shows the results of the Paired Sample t-test between the Pre-test Treatment Score versus the Post-test Treatment Score and the Pre-test Control Score versus the Post-test Control Scores. As stated in the table, there was no statistically significant difference found in both analyses.

Table 3:  
*Paired Samples test comparing the difference between the pretest and post-test scores in the treatment group*

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test Treatment Score – Post-test Treatment Score</td>
<td>-.10</td>
<td>4.36</td>
<td>.98</td>
<td>-2.14</td>
<td>1.94</td>
<td>-2.14 - 1.94</td>
<td>-.10</td>
<td>19</td>
</tr>
<tr>
<td>Pre-test Control Score – Post-test Control Score</td>
<td>-.58</td>
<td>3.45</td>
<td>.79</td>
<td>-2.24</td>
<td>1.09</td>
<td>-2.24 - 1.09</td>
<td>-.73</td>
<td>18</td>
</tr>
</tbody>
</table>

p<.05*
**Independent Sample T-Tests**

Table 4:

*Independent Sample t-Tests – Test Scores*

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tail)</th>
<th>Mean Diff.</th>
<th>Std. Error Diff.</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Control Score – Pretest Treatment Score</td>
<td>5.09</td>
<td>0.03*</td>
<td>-1.20</td>
<td>37</td>
<td>.24</td>
<td>-1.06</td>
<td>.89</td>
<td>-2.86, .74</td>
</tr>
<tr>
<td>Post-test Treatment Score – Post-test Control Score</td>
<td>2.42</td>
<td>0.13</td>
<td>-1.38</td>
<td>39.00</td>
<td>0.17</td>
<td>-1.27</td>
<td>0.92</td>
<td>-3.13, 0.59</td>
</tr>
<tr>
<td>Pretest Treatment Score – Post-test Homecroft</td>
<td>11.40</td>
<td>0.00*</td>
<td>2.29</td>
<td>45.00</td>
<td>0.03</td>
<td>1.67</td>
<td>0.73</td>
<td>0.20, 3.13</td>
</tr>
<tr>
<td>Post-test Treatment Score – Post-test Homecroft</td>
<td>10.42</td>
<td>0.00*</td>
<td>2.68</td>
<td>46.00</td>
<td>0.01</td>
<td>1.95</td>
<td>0.73</td>
<td>0.48, 3.41</td>
</tr>
</tbody>
</table>

p<.05

The table above (table 4) shows the results of an independent-samples t-test between the Pretest Control Score – Pretest Treatment Score, Post-test Treatment Score – Post-test Control Score, Pretest Treatment Score – Post-test Homecroft, Post-test Treatment Score – Post-test Homecroft. An analysis of the Pretest Control Score – Pretest Treatment Score and the Post-test Treatment Score – Post-test Control revealed a non-significant difference in scores per Table 4 above per the Group scores for the 5th grade students from the North Shore Community School. However, there was a significant difference between the treatment group and the Homecroft Elementary School control (measured at post-test). This significant difference points to the fact that Homecroft Elementary School students served as a better control group due to their similar location in Duluth and similarity in school philosophy of Environmental Education.

The students at HES were assessed for the purposes of comparing their level of knowledge of trees and attitudes towards the environment. An analysis of statistical significance
between the Homecroft group and the Pretest Treatment group also resulted in a statistically significant difference indicating a difference in the level of knowledge the students possess about trees from the onset. There could be a few reasons for this disparity, which will be discussed into further detail in the following chapter. Students from North Shore Community School and Home Croft Elementary were asked in the post-test (treatment & control groups) what helped them learn about trees better. The options were chosen to represent a wide variety of available resources for learning. See Figures 5 & 6 for their respective responses.

Figure 5: *Attitudes for NSCS control group - What Helped You Learn about Trees Better?*
In Figure 5 & Figure 6 above, students in the North Shore Community School classes indicated that their highest source of learning about nature during the lesson and when not in class was when using the Tree ID keys with the n=8 (40.0%) & n= 8(38.1%). This information applies for both groups regardless of the use of technology. Thus, this indicates a sense that there was not as strong connection between technologies such as the internet compared to the paper-based Tree ID keys for both groups in the North Shore Community School. The internet only comes second n=4 (20.0%) to the use of Tree ID keys only in the Post-test Treatment group.
which had access to use Project Noah.

Figure 7 displays the results for Homecroft Elementary School. In this figure the option "Other" has the highest frequency with the next highest response being no-response. This option was an open-ended question that gave the students from HES the opportunity to indicate what the strongest influence was. Examples of the "other" responses were: "Wolf Ridge" and "Forestry Field Day". More importantly "The Internet" and "Pictures" had the next two highest frequencies of n=5, 20% and n=4, 14.8% respectively. This result reflects the fact that HES was not taken through the lesson taught to students at NSCS. One must also take into account that this could point to the absence of a physical guide (Tree ID key – This key was sourced from Wolf Ridge curriculum materials and guides by independently identifying trees based on leaves structure etc.), referring to this group of students, the internet and pictures played a dominant role among the categorized options.
Attitudes – Treatment Group

RQ (2): How the inclusion of technology influences student’s participation and interest in nature?

To pursue this outcome, a 5-point Likert style set of questions were asked to assess students’ perceived commitment/advocacy and general feelings toward the environment. An independent sample t-test between the pretest and posttest of the treatment group yielded no significant results at a 95% confidence (see Table 5) indicating that there was not a strong change in attitudes between the pretest and the posttest. There may be a few reasons as to why this is the case, the most prominent reason being the already high and positive collective attitude of the participants from the North Shore Community School (mean for pretest = 3.96 out of 5). The Homecroft group has no measure for any shift in respondent attitudes because participants only took a posttest. The treatment group had exposure to the web-based EE resource by way of Project Noah. Therefore, the inclusion of technology did not factor enough in learning between the pretest and the post-test of the treatment group.
Table 5:  
*Paired Samples Test for Attitudes: Treatment-Pretest vs Post-test*

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(15) Learn about nature</td>
<td>.10</td>
<td>1.71</td>
<td>.38</td>
<td>-.70 - .90</td>
<td>.26</td>
<td>.80</td>
</tr>
<tr>
<td></td>
<td>-.60</td>
<td>1.50</td>
<td>.34</td>
<td>-1.30 -.10</td>
<td>-</td>
<td>.09</td>
</tr>
<tr>
<td>(16) Learn about science</td>
<td>.05</td>
<td>1.05</td>
<td>.23</td>
<td>-.44 .54</td>
<td>.21</td>
<td>.83</td>
</tr>
<tr>
<td>(17) Play outside in good weather</td>
<td>.05</td>
<td>1.05</td>
<td>.23</td>
<td>-.54 .44</td>
<td>-21</td>
<td>.83</td>
</tr>
<tr>
<td>(18) I like to be outside in nature</td>
<td>.00</td>
<td>1.78</td>
<td>.40</td>
<td>-.83 .83</td>
<td>.00</td>
<td>1.00</td>
</tr>
<tr>
<td>(19) How often reading &amp; watching vid. about environment</td>
<td>.00</td>
<td>1.78</td>
<td>.40</td>
<td>-.83 .83</td>
<td>.00</td>
<td>1.00</td>
</tr>
<tr>
<td>(20) Be out in forest</td>
<td>-.25</td>
<td>1.16</td>
<td>.26</td>
<td>-.79 .29</td>
<td>-.96</td>
<td>.35</td>
</tr>
<tr>
<td>(21) Ask friends</td>
<td>-.05</td>
<td>2.14</td>
<td>.48</td>
<td>-1.05 .95</td>
<td>-.10</td>
<td>.92</td>
</tr>
<tr>
<td>(22) Like to be in nature</td>
<td>.05</td>
<td>2.09</td>
<td>.47</td>
<td>-.93 1.03</td>
<td>.11</td>
<td>.92</td>
</tr>
</tbody>
</table>

*Attitudes – Control Group*

As shown in Table 6 there was no significant difference in any of the 8 attitudes-based questions for the control group. In the control group there were similar results regarding a statistically significant difference between the pretest and post-test of the control group. It is however worth noting that there was a slightly stronger difference between the pretest and posttest stages for the control group. It is of interest to note that this is the group that didn’t use technology and experienced a slightly stronger improvement in attitudes even though still not significant. This may be attributed to the effects of confounding variables such as weather conditions and the availability of time on collected results.
RQ (3): What are the changes in attitudes towards the environment for 5th grade students who used technology as a tool in the study versus those who did not?

The main differentiating factor between the experiences of two groups was the inclusion of technology in the treatment group’s lesson. As shown in Table 8 & 9, attitudes toward nature between the treatment and control group were not affected significantly with either group. This points to the fact that the presence of technology in the treatment groups did not improve learning between the pretest and post-test.

Summary of results

In conclusion, it was found out that students' scores in the treatment and control groups for the North Shore Community School did not experience a statistically significant change between the pretest to the post-test. This could be due to a myriad of factors, which will be
discussed in the next chapter. The highest response choices for the control and treatment groups for the question ‘What helped you learn about trees better’ indicates ‘tree ID keys’ for both treatment and control groups and ‘Other’ (for the Homecroft group - an experience at the Wolf Ridge Environmental Learning Center). Attitudinal change between the post-test and pretest yielded no significant difference in both the treatment and control groups. This could be attributed to the already high level of positive attitudes the students possess due to the nature of the education they receive at North Shore Community School.
Chapter 5

Summary

As stated in the introduction, the purpose of this study was to find out the effect of the use of technological tools in the teaching of a lesson in Environmental Education in the formal classroom. This study used an internet-based environmental education program called Project Noah and examined the learning outcomes of students’ learning by collecting quantitative data and assessing attitudes towards nature and the environment. The research questions that guided the results for the project are as follows:

Research Questions

1. What is the effect of technology on learning outcomes of students in a tree ID class project versus that of a control group?

2. How does the inclusion of technology influence students’ participation and interest in nature?

3. What are the changes in attitudes towards the environment for 5th grade students who used technology as a tool versus those who did not?

Discussion

The first research question aims to find out the effect of the inclusion of technology on students’ learning outcomes. The control and treatment groups did not have a significant difference which was then interpreted as two similar groups of 5th grade students and therefore also as two equivalent groups. There may be a few reasons why the study did not show a difference between the pretest and posttest of the treatment group nor the control group of the NSCS. Following are some reasons that could apply to the NSCS groups as confounding variables:
This study was conducted as part of regular curriculum and included 6 lessons with excursions into the school forest over a period of 6 weeks (3 lessons). For this reason, there were several events that occurred that appear to have caused confounding variables that may have obscured the results:

1. The weather. This study was conducted during the peak winter season in the months of February and early March. Due to the cold weather conditions and the season’s effects on trees (no leaves), there was a stark difference between the trees that were posted in Project Noah, tree images used in the questionnaire and the actual tree’s appearance when the children went outdoors causing a disparity in representation of what the actual trees were when they had to answer test questions.

2. The effect of time constraints. The teacher for the lessons was restricted to one hour (60 minutes) per session per week. As a result, there was insufficient time to administer the actual lesson for the control and the pretest group together and therefore had to be split into the deciduous trees lesson and the coniferous trees lesson. This matters because the presence of time-constraints, though not surprising in the formal school setting, may have created testing error in measurement.

For the treatment group the process of going through the lesson involved the use of technology. Regardless of this, results from the study have showed that this was not a strong enough determinant to bolster interest and learning both about nature and about trees. Some other reasons may point to the fact that trees may not be a priority or an area of interest for the students. Students in the treatment group were tasked with taking pictures and uploading detailed descriptions of the trees on to the Project Noah website. However, due to the limitation of time, students were not able to fully complete that section of the experience. Regardless of these
impediments, it is safe to assume that Project Noah was not sufficient as a supplement to the original lesson which goes against the research question that the lesson which included technology would positively affect learning and attitudes.

As discussed in the literature, a goal of educational technology is to be able to assist in the development, design, utilization, managing and evaluating technological resources for teaching and learning (Januszewski & Molenda, Educational Technology - A Difference with Commentary, 2008). More importantly, Januszewski and Molenda (2008) claim that the ultimate purpose of educational technology is to "improve performance". This study has however shown that in many instances, the introduction of technology does not guarantee an improvement in understanding of the subject matter nor does it deliver consistently on test scores per the scope of this study. This raises questions about the effectiveness of other existing programs, which have a technology component. Also, specifically, a consideration of Project Noah’s educational features points to the possibility and potential lack of its effectiveness on increasing positive attitudes and improving cognitive learning (relating to the environment).

Educational technology is rapidly growing (Weigel, James, & Gardner, 2009) and in some cases has been used as a conduit for instruction in Environmental Education lessons in the formal classroom setting. The trend is growing where organizations such as the National Environmental Education Foundation’s ‘Greening Stem‘ and online software such as Project Noah are going to be included more and more into the formal classroom and used as resources. Thus, it is important for the EE community and organizations such as the National Environmental Education foundation to adopt and rely heavily on research that assesses aforementioned effectiveness and also ensure that lessons are adapted more painstakingly. The SAMR model is an example of a model that could help guide this transformation. This study
shows that the teacher needs to be taught how to use the technology properly, including the season, time allotment, instructional continuity, and appropriate supporting materials (such as tree id guides) in order to allow the technology to enhance student learning. Simply having the technology seems inadequate to enhance student learning and should not be assumed to simply be ‘intuitive’ in its use.

Implications for EE

The lessons learned in this study are critical. At the umbrella level, Environmental Education seeks to create a population that understands the complex nature of the natural and built environments resulting from the interaction of their biological, physical, social, economic, and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment.‘ (United Nations Educational, Scientific and Cultural Organization (UNESCO); United Nations Educational Program (UNEP), 1977) This very urgent goal has the potential to find an ally in technology. For this to happen successfully it is essential to have partnerships that can drive the continued advent of Environmental Education.

Project Noah did not perform well as an internet source of learning. Regardless of this, it appears to possess potential as a tool that can be of great assistance to a formal classroom teacher, given proper training to the teacher. What this study indicates is that technology should not be restricted to a single internet program when there are larger resources on the internet. Research can be guided in a way that fosters exploration and takes advantage of the colossal amount of information that exists on the internet today. Students with the power of the internet at
hand, have the benefit of exploring all of these concepts and activities in a way that helps Environmental Education achieve all its targets in the coming decades.

**Further Research Considerations**

The assessment on the effects of internet-based educational technology on learning especially in the formal classroom has been widely researched and is a central piece of this study. However, this is not the case for the studying of Environmental Education in the formal classroom. This study used Project Noah as the technological tool to teach Environmental Education in the formal classroom setting. Here is a list of future considerations for this research:

1. Time consideration
2. Considering alternatives to Project Noah
3. Consistency of the Tree ID instruction/lesson
4. More training for the teacher- Ensure that the teacher is trained on the use of technology for possibly better results.
5. Could having the actual teacher doing the research have a more positive effect?
6. There must be stronger partnerships between Environmental Education and technology companies interested in Formal education in the context if this study.

Although there wasn’t a significant difference between the pretest and the posttest of the treatment and control group for North Shore Community School, it is paramount to remember that there was marginally higher difference between the North Shore Community School and Homecroft Elementary School scores in the posttest. What this means is that there was already a high level of positive environmental attitudes, which made it less likely to find a change.

The scope of this study limits the generalization of results to the schools the study was performed in. For this study, there are a few things that could make the process of data collection
and analysis a smoother process. As described in the earlier sections of the discussion, time was a very crucial limiting factor. The coordination between the Environmental Education instructor at NSCS and the teachers of the students who are primarily responsible for the dissemination of all other knowledge and learning have precedent over students’ time management. As a result of this it was very difficult to get an extended period of time with the students to be able to accommodate the entire lesson. Thus, any parties considering doing a study of this nature are strongly recommended to partner with school leadership beyond simply getting permission to actually creating a larger chunk of time. This can be a possible explanation of how to enhance student learning using this type of internet-supported pedagogy.

Another future consideration is to ensure that the season and content align. For this study the lesson and data collection process was undertaken during the winter. Since most trees except the evergreens shed their leaves during the preceding season, there could have been a disconnect between the lessons and the testing. The lack of leaves on trees in the limited the learning experience as a whole. Due to the lack of time, students learned by actually going outside and experiencing the trees firsthand but had to test with pictures. With more time there will be a potentially better experience and in turn a potentially higher chance of enhancing student learning.
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Continuous Improvement in Student Learning:

http://uncgqep.uncg.edu/forms/Handout_Student_Learning_Outcomes_101__8_7_06.pdf


**Appendices**

Appendix A: Permission Letter (Letter of Endorsement)

Appendix B: Lessons

Appendix C: Instrument (Pre & Post Test)
Appendix A: Permission Letter (Letter of Endorsement)
Appendix A – Permission Letter (Lesson of Endorsement)

North Shore
Community School

5926 Ryan Road, Duluth, MN 55804 • 218.525.0663 • www.northshorecommunityschool.org

Director
North Shore Community School
5926 Ryan Rd.
Duluth, MN
55804

Institutional Review Board
D528 Mayo Memorial Building
420 Delaware Street SE
Minneapolis, MN
55455

January 2015

Permission to Conduct Research at North Shore Community School

Dear Institutional Review Board:

The purpose of this letter is to inform you that I give Augustus Arthur, a master’s student from the University of Minnesota Duluth, permission to conduct the research titled ‘The Inclusion of Environmental Education in Formal Education Through the use of Educational Technology; A Study of Project Noah’ at the North Shore Community School. This also serves as assurance that this school complies with requirements of the Family Educational Rights and Privacy Act (FERPA) and the Protection of Pupil Rights Amendment (PPRA) (see next page for specific requirements) and will ensure that these requirements are followed in the conduct of this research. The anonymity of the young subjects who will partake in the study will be preserved at every stage per the FERPA and PPRA federal regulations.

Sincerely,

Susan Rose
Director – North Shore Community School
Appendix A – Permission Letter (Lesson of Endorsement)

North Shore Community School

5926 Ryan Road, Duluth, MN 55804 · 218.525.0663 · www.northshorecommunityschool.org

Protection of Pupil Rights Amendment (PPRA)

- The right of a parent of a student to inspect, upon the request of the parent, a survey created by a third party before the survey is administered or distributed by a school to a student.

- Any applicable procedures for granting a request by a parent for reasonable access to such survey within a reasonable period of time after the request is received.

- Arrangements to protect student privacy that are provided by the agency in the event of the administration or distribution of a survey to a student containing one or more of the following items (including the right of a parent of a student to inspect, upon the request of the parent, any survey containing one or more of such items): Political affiliations or beliefs of the student or the student’s parent. Mental or psychological problems of the student or the student’s family. Sex behavior or attitudes. Illegal, anti-social, self-incriminating, or demeaning behavior. Critical appraisals of other individuals with whom respondents have close family relationships. Legally recognized privileged or analogous relationships, such as those of lawyers, physicians, and ministers. Religious practices, affiliations, or beliefs of the student or the student’s parent. Income (other than that required by law to determine eligibility for participation in a program or for receiving financial assistance under such program).

- The right of a parent of a student to inspect, upon the request of the parent, any instructional material used as part of the educational curriculum for the student. Any applicable procedures for granting a request by a parent for reasonable access to instructional material received.

- The administration of physical examinations or screenings that the school or agency may administer to a student.

- The collection, disclosure, or use of personal information collected from students for the purpose of marketing or for selling that information (or otherwise providing that information to others for that purpose), including arrangements to protect student privacy that are provided by the agency in the event of such collection, disclosure, or use.

- The right of a parent of a student to inspect, upon the request of the parent, any instrument used in the collection of personal information before the instrument is administered or distributed to a student.

- Any applicable procedures for granting a request by a parent for reasonable access to such instrument within a reasonable period of time after the request is received.
Family Educational Rights and Privacy Act (FERPA)

The Family Educational Rights and Privacy Act (FERPA) (20 U.S.C. § 1232g; 34 CFR Part 99) is a Federal law that protects the privacy of student education records. The law applies to all schools that receive funds under an applicable program of the U.S. Department of Education.

FERPA gives parents certain rights with respect to their children's education records. These rights transfer to the student when he or she reaches the age of 18 or attends a school beyond the high school level. Students to whom the rights have transferred are "eligible students."

- Parents or eligible students have the right to inspect and review the student's education records maintained by the school. Schools are not required to provide copies of records unless, for reasons such as great distance, it is impossible for parents or eligible students to review the records. Schools may charge a fee for copies.

- Parents or eligible students have the right to request that a school correct records which they believe to be inaccurate or misleading. If the school decides not to amend the record, the parent or eligible student then has the right to a formal hearing. After the hearing, if the school still decides not to amend the record, the parent or eligible student has the right to place a statement with the record setting forth his or her view about the contested information.

- Generally, schools must have written permission from the parent or eligible student in order to release any information from a student's education record. However, FERPA allows schools to disclose those records, without consent, to the following parties or under the following conditions (34 CFR § 99.31):
  - School officials with legitimate educational interest;
  - Other schools to which a student is transferring;
  - Specified officials for audit or evaluation purposes;
  - Appropriate parties in connection with financial aid to a student;
  - Organizations conducting certain studies for or on behalf of the school;
  - Accrediting organizations;
  - To comply with a judicial order or lawfully issued subpoena;
  - Appropriate officials in cases of health and safety emergencies; and
  - State and local authorities, within a juvenile justice system, pursuant to specific State law.
Appendix B: Lessons - Control & Treatment Group Lessons
Introduction to Tree ID

Curricular Area: Science, EIC
Season: Fall
Duration: 60 minutes
Key Points: Tree ID, Dichotomous key, observations, nature journaling

Overview

In this lesson students will go take a Tree ID pre-test using a Trees and Keys course created along the edge of the field and school forest. Students will then begin learning about how to use a dichotomous key.

Learning Objectives

As a result of participating in this lesson, students will:

1. Complete a pre-test of Tree ID.
2. Sketch alternate and opposite branches in their nature journals.

Background Information

- Students have been introduced to the idea of nature
- See list of trees near NSCS at end of lesson plan for general tree location for creating Trees and Keys course
- See Wolf Ridge Trees and Keys lesson plan (behind this in 5th grade binder) for more about tree ID

Materials

- Orange numbers for marking trees
- Ribbon or string
- Pictures of trees without leaves if you do this lesson after the leaves have fallen
- Tree ID pre-test for each student
- Clipboard for each student
- Pencils and nature journals provided by students
- Beginner’s Guide to MN Trees (classroom set of 25 located in EE school forest bin)
APPENDIX B - Control Group Lesson

- *Sign of the Beaver* Promethean Board Tree ID intro
- Maple branch and oak or aspen branch for opposite and alternate comparison

**Preparation**

- Remind students and teachers to dress warmly if the weather is chilly!
- Create the Trees and Keys course
- Go back to the spruce tree on the trail to the red shelter and get some branches to place out for the spruce ID stop
- Read *The Sign of the Beaver* by Elizabeth George Speare (if the students have read this book in class aloud or in small groups again)

**Procedure**

*Introduction* (10 minutes)

1. Show the Promethean Board presentation showing all the ways Matt and Attean used trees in *The Sign of the Beaver*. Ask students if they would know what trees to use to make all the different things. It wasn’t just that Matt and Attean knew to use trees, they knew exactly which type of tree to use for what. We are going to learn to identify trees so that we would know which tree to use if we wanted to do a certain thing with it.
2. Ask students to share other things they do with specific types of trees.
3. Explain the task:
   a. We will go out and you will do this Tree ID pre-test.
   b. It is a pre-test. You are not graded on it. It just shows me how much you already know and how much you learn by the time of the real test after we learn this information. I don’t expect you to get all the answers right since I’ve never taught you about tree ID.
   c. You need: Tree ID pre-test, Guide to MN Trees booklet, nature journal, pencil, clipboard
   d. Go get warmly dressed.
4. Go outside.

*Tree ID Pre-test* (25 minutes)

1. Head out to the swale. Gather students and point out the last tree on each side of the field.
2. Explain that when you get to a tree, look at the number. Write what you think the name of the tree is next to the number that matches the tree. Use the nearest tree for an example.
3. Students may use their tree field guides if they want (basically to see if they know how to use a dichotomous key).
4. Come back when you hear the teacher howl like a wolf.
5. Monitor students as they move about completing the pre-test.
6. Gather students.
APPENDIX B - Control Group Lesson

**Dichotomous Key Intro** (10 minutes)

1. Return to the room if students are too cold to continue outside.
2. Tell them what a dichotomous key is (2 choices at each point).
3. Go over opposite and alternate (picture on page 16).
4. Show an example of a maple vs. oak branch if inside or whole trees if outside.
5. Students can look at page 16, at the examples of maple and aspen twigs, and at the pictures of opposite and alternate branches on the Promethean Board presentation and sketch an opposite and an alternate branch in their nature journal.

**Wrap-up** (1 minute)

1. Explain that we will continue learning to use the dichotomous key and how to ID trees.

**Safety Precautions:**

- Always bring the following onto the nature trail:
  - Radio
  - First Aid Kit

**Modifications**

**Extensions**

**Nature Journal**

1. Go out to the woods near the field and pick a new spot for hunting season/visit the new spot you found during EE. Once in your spot find examples of both opposite and alternate branches and carefully sketch an example of both. Students should sketch as carefully as they did the first time we sketched a maple leaf. Don't forget the date and the weather on the journal page. If a student cannot find both examples, they should move around until they find one (suggestion: Maple to the left of Chickadee landing for opposite; any oak or aspen along the edge of the forest towards the pavilion for alternate).

**Language Arts**

1. Imagine that you are Matt or Attean in *Sign of the Beaver* or a different character in a book that you read this year. Write about all the ways you could use trees in a single day. Or, write a story about a particular activity (i.e. fishing) and explain how you would use trees for that activity.
2. Imagine that you are Matt or Attean in *Sign of the Beaver* or a different character in a book that you read this year. Write a “how-to” essay about how to make a fish-hook, bow, or other item out of wood. Include what kind of tree to make the item out of (reference the book if you can’t remember what kind of wood the character used).
APPENDIX B - Control Group Lesson

3. Look back through *Sign of the Beaver* and list all the ways Matt and Attean used trees to survive (see a list on the Promethean Board presentation *Sign of the Beaver*). Or use a different book.

Math

1. Look at the ways that Matt and Attean used wood in *Sign of the Beaver* (see a list on the Promethean Board presentation *Sign of the Beaver*). Graph the different types of wood they used and see which was used most frequently.

Additional book suggestions for young adult historical fiction with the woods and survival as themes:

Island of the Blue Dolphins by Scott O’Dell

Hatchet by Gary Paulson

My Side of the Mountain by Jean Craighead George

Julie of the Wolves by Jean Craighead George

Brian’s Winter by Gary Paulson

The River by Gary Paulson

Suggestions from www.librarything.com

Subject: Wilderness survival › Fiction

The Brief History of the Dead by Kevin Brockmeier (1,681 copies)
Deliverance by James Dickey (1,154 copies)
Into the Forest by Jean Hegland (744 copies)
Alabama Moon by Watt Key (333 copies)
Wild Life by Molly Gloss (213 copies)
The Sky So Big and Black by John Barnes (133 copies)
Northern Lights by Tim O'Brien (127 copies)
Hunted Past Reason by Richard Matheson (121 copies)
Snow Mountain Passage by James D Houston (115 copies)
Wild Man Island by Will Hobbs (111 copies)
Wrong Place, Wrong Time by Andrea Kane (109 copies)
Cold Springs by Rick Riordan (87 copies)
The Frozen Deep [collection of novellas] by Wilkie Collins (86 copies)
Midnight Sun by Kat Martin (77 copies)
Afterlands by Steven Heighton (71 copies)
In the Forest of Harm by Sallie Bissell (70 copies)
The Cage by Audrey Schulman (64 copies)
APPENDIX B - Control Group Lesson

Getting Air by Dan Gutman (60 copies)
Scott Free by John Gilstrap (59 copies)
Lord Grizzly by Frederick Manfred (50 copies)
The Deceivers (Beyond Belief Campaign) by Josh McDowell (37 copies)
This Wild Silence: A Novel by Lucy Jane Bledsoe (31 copies)
Wilderness by Roger Zelazny (26 copies)
Midnight Sun by Elwood Reid (19 copies)
The Devil You Know: A Novel by Wayne Johnson (19 copies)
Survive: Stories of Castaways and Cannibals by Nate Hardcastle (19 copies)
Northern Edge by Barbara Quick (8 copies)
Marquesas (Survivor) by Kim Ostrow (2 copies)
The Amazon by Katherine Noll (1 copies)

Resources:

*Sign of the Beaver* by Elizabeth George Speare.

<table>
<thead>
<tr>
<th>Trees Near NSCS Building and School Forest</th>
<th>Line of trees by parking lot and baseball field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge of field/forest</td>
<td>Red Pine</td>
</tr>
<tr>
<td>Aspen</td>
<td>Jack Pine</td>
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<tr>
<td>Birch</td>
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<tr>
<td>White Oak</td>
<td>fenced trees near swale/ditch by pavilion</td>
</tr>
<tr>
<td>Sugar Maple</td>
<td>Northern White Cedar</td>
</tr>
<tr>
<td>Balsam Fir</td>
<td>White Pine</td>
</tr>
<tr>
<td>Further back in school forest</td>
<td>Tamarack</td>
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<tr>
<td>Spruce</td>
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<tr>
<td>White Pine</td>
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<tr>
<td>Ash?</td>
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</tbody>
</table>
Tree ID Part 2

Curricular Area: Science, EIC
Season: Winter
Duration: 60 minutes
Key Points: Tree ID, Dichotomous key, observations, nature journaling

Overview

In this lesson students will learn about dichotomous keys and tree ID vocabulary. Students will learn about dichotomous key vocabulary for describing coniferous trees. Students will ID 1 coniferous tree in their special spot using their nature journals. Students will sketch at least 2 types of coniferous needle bundles.

Learning Objectives

As a result of participating in this lesson, students will:

3. Help create a dichotomous key to ID classmates.
4. Use a dichotomous key to correctly ID at least one coniferous tree in or near their special spot.

Background Information

- See Wolf Ridge Trees and Keys lesson plan (behind this in 5th grade binder) for more about tree ID
- Students have taken a tree ID pre-test and been introduced to the idea of opposite and alternate branches

Materials

- Pencils and nature journals provided by students
- *Beginner’s Guide to MN Trees* (classroom sets should be in classrooms)
- Maple branch and oak or aspen branch for opposite and alternate comparison
- 5 Tree ID Part 2 Promethean Board Presentation

Preparation
APPENDIX B - Control Group Lesson

- No special prep needed for this lesson

Procedure

Introduction (5 minutes)

5. Ask students if they went back to their special hunting season spots near the field. Did they sketch opposite and alternate branches? What else did they observe while at their special spots?
6. Have students stand up and model opposite and alternate again with their arms.
7. Explain that we are going to slowly learn all of the vocabulary that we need to use the Dichotomous key. Today we will focus on the words for IDing coniferous trees.

Dichotomous Key Use (15 minutes)

1. Explain that today we are going to learn more about how to use the dichotomous key.
2. Explain the rules for using a Dichotomous key:
   a. Always start at #1 on Tree Key.
   b. Always read both a. and b.
   c. Choose description that is most accurate.
   d. Follow directions until you I.D. tree.
   e. Write tree's name in correct spot on your paper.
3. Show the 5 Tree ID Part 2 Promethean Board presentation. Create a Dichotomous Key for students in the classroom. Be sure to use characteristics that can be observed by looking at the students since that is what we want to do when we are IDing trees. Call Barry or Sue to come down and figure out ID kids on the key.

Coniferous Tree ID (20 minutes)

7. Go over coniferous tree ID vocab including needle bundles, clusters, singles on Promethean Board presentation.
9. Go to the coniferous trees along the road by the parking lot. ID the Red and Jack Pines together as a class.
10. Move to the start of the nature trail. Give students time to work in pairs to ID a Balsam Fir. Give them the “flat, friendly Fir” trick and show them the “fir-arri stripe.”
11. Walk down the nature trail to the Spruce. Show students the 4-sided, square needles and how to roll them in your fingers.

Special Spots (15 minutes)

6. Visit the special spots in the school forest. Students can find coniferous trees in their special spot. ID the tree using your dichotomous key and write the correct name (spelled correctly!) in your journal.
7. If they have time, they can sketch the needles of one coniferous tree growing in or near
your special spot. If the tree has needles growing in a bundle, make sure to include the correct amount of needles in the bundle in the sketch.

Wrap-up (5 minute)

2. Explain that we will continue learning to use the dichotomous key and how to ID trees.
3. Ask students what they learned today that they didn’t know before about coniferous trees.
4. Give two follow-up assignments.
   a. (If there wasn’t time in the lesson, or see b.) Return to your special spot and find a coniferous tree. ID the tree using your dichotomous key and write the correct name (spelled correctly!) in your journal. Sketch the needles. If the tree has needles growing in a bundle, make sure to include the correct amount of needles in the bundle.
   b. Find at least one other coniferous tree and sketch the needles. ID the tree using your dichotomous key and write the correct name (spelled correctly!) in your journal.

Safety Precautions:

- Always bring the following onto the nature trail:
  - Radio
  - First Aid Kit

Modifications

- Students who need extra guidance can be paired up with students who have the hang of using dichotomous keys.
- Students can work with or near the teacher.

Extensions

Nature Journal

2. Find yet another kind of coniferous tree. ID the tree and write the name in your nature journal. Sketch this tree’s needles.
3. Go as a class to the big Spruce on the nature trail. Take time to have everyone sketch the needles and branches. They might not see any other Spruce on the nature trail.
4. Go as a class to the Tamarack in the swale near the pavilion. Take time to have everyone sketch the needles and branches. They won’t see any other Tamarack on the nature trail.

Language Arts

1. Research some facts about a coniferous tree. Write at least 3 (or 5) facts about that tree in your nature journal. Include a sketch of the tree or a tree branch.
2. On a large piece of paper create a chart of all the coniferous trees we have at North Shore. Carefully, neatly, and correctly label each tree species with the common name. Also consider including nick names (i.e. Norway Pine) or Latin names.
APPENDIX B - Control Group Lesson

3. Break students into groups to research coniferous trees. Write questions about the tree based on tree facts. Use the questions to play Tree Jeopardy!

Math

2. ID the coniferous trees in a certain patch of forest (for example, the line of trees by the parking lot and baseball field). Graph the results of what species you IDed.

Resources:

*Trees and Shrubs* Peterson Field Guide (one in EE office)

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<td>Ash?</td>
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</tbody>
</table>
Overview
In this lesson students will review coniferous tree ID by going out to their special spots and IDing trees. They will also make observations at their spots.

Learning Objectives
As a result of participating in this lesson, students will:

5. Use a dichotomous key to correctly ID at least one coniferous tree in or near their special spot.
6. Make at least 3 observations about their special spot.

Background Information
- See Wolf Ridge Trees and Keys lesson plan (behind this in 5th grade binder) for more about tree ID
- In the previous lesson, students learned about coniferous tree ID and how to use Dichotomous keys. It has been about 5 weeks since that lesson due to the holiday break, snow days, and cold days. Thus, I decided to use this session to review rather than to move on to winter deciduous tree ID.

Materials
- Beginner’s Guide to MN Trees (classroom sets should be in classrooms)
APPENDIX B - Control Group Lesson

- No special prep needed for this lesson
- Let teachers know that students can be ready to go outside if at all possible.

Procedure

Introduction (5 minutes)

8. If students aren’t ready to go out or are finishing getting ready, they can do so.

9. Ask students if they went back to their special hunting season spots near the field. Did they ID a coniferous tree? What kind was it? What else did they observe while at their special spots?

10. Explain that we will go adventuring through the snow to our special spots to do tree ID and make observations. Students need to make at least 3 observations and ID at least 2 trees in or near their spot. They will have to try to remember all of this information because we won’t take journals out with us because they may get wet or lost or students’ fingers may just be too cold to write.

Special Spots (45 minutes)

8. Visit the special spots far back in the school forest. Students can find coniferous trees in their special spot.

9. Give students some time to make at least 3 observations.

10. Walk around to the students and ask them to share one observation. Give them a tree ID booklet. Students must ID at least 2 trees using their dichotomous key. They can work with someone nearby if they need help.

11. If they finish early, students can make additional observations.

Wrap-up (5 minute)

1. Gather the students. Let anyone who wants to share an observation from their spot.

2. Adventure back to the school in the deep snow.

Safety Precautions:

- Always bring the following onto the nature trail:
  - Radio
APPENDIX B - Control Group Lesson

- First Aid Kit

** Modifications **

- Students who need extra guidance can be paired up with students who have the hang of using dichotomous keys.
- Students can work with or near the teacher.

** Extensions **

** Nature Journal **

5. As a class, go over the differences between spruces and balsam firs. Sketch the two types (by looking at a tree field guide, the MN tree ID booklet, or going out on the nature trail to one of the trees on a warmer day) and label them. Make notes about differences between the two types such as the shape of the needles, the way the needles grow out around the branches, etc.

6. Go as a class to the Tamarack in the swale near the pavilion. Take time to have everyone sketch the needles and branches. They won’t see any other Tamarack on the nature trail.

** Language Arts **

4. Research some facts about a coniferous tree. Write at least 3 (or 5) facts about that tree in your nature journal. Include a sketch of the tree or a tree branch.

5. On a large piece of paper create a chart of all the coniferous trees we have at North Shore. Carefully, neatly, and correctly label each tree species with the common name. Also consider including nick names (i.e. Norway Pine) or Latin names.

6. Break students into groups to research coniferous trees. Write questions about the tree based on tree facts. Use the questions to play Tree Jeopardy!

** Math **

3. Measure the needles of a variety of coniferous trees (ID the trees first!). Make a graph recording the results of everyone’s measurements. What are the longest coniferous needles we have around NSCS? The shortest?

4. Pick a small plot of land with a small group of students. Work together to ID all of the coniferous trees in your plot. Keep a tally of the types of trees you ID. Put all of your data together as a class and figure out the total numbers of various types of coniferous trees in the section of grounds you were on (I bet there will be lots of balsam fir!).
## APPENDIX B - Control Group Lesson

### Resources:

*Trees and Shrubs* Peterson Field Guide (one in EE office)

**Trees Near NSCS Building and School Forest**

<table>
<thead>
<tr>
<th>Edge of field/forest</th>
<th>Line of trees by parking lot and baseball field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspen</td>
<td>Red Pine</td>
</tr>
<tr>
<td>Birch</td>
<td>Jack Pine</td>
</tr>
<tr>
<td>White Oak</td>
<td></td>
</tr>
<tr>
<td>Sugar Maple</td>
<td>Fenced trees near swale/ditch by pavilion</td>
</tr>
<tr>
<td>Balsam Fir</td>
<td>Northern White Cedar</td>
</tr>
<tr>
<td></td>
<td>White Pine</td>
</tr>
<tr>
<td>Further back in school forest</td>
<td>Tamarack</td>
</tr>
<tr>
<td>Spruce</td>
<td></td>
</tr>
<tr>
<td>White Pine</td>
<td></td>
</tr>
<tr>
<td>Ash?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix C: Instrument
Date: _____/_____/

Tree ID - Questionnaire

Please share what you know about the types of trees in your school forest and how you feel about nature. This is not a test. Your answers will be totally anonymous, so please do not write your name on this paper.

Do your best to answer all the questions as well as you can. Call for the instructor if you have any questions or don’t understand something in this test.

[Questions begin on the next page]

What you know about trees.
**Directions:** Go to each numbered tree or tree specimen. Write the name of the tree on the answer sheet by the number that matches the tree’s number. For example, if the tree was labeled with the number 4, you would write the name of the tree by the number 4 below.

The box below contains the list of trees you will be identifying from the images of trees you will be given. Each tree will be used only once below.

<table>
<thead>
<tr>
<th>List of Tree Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaking Aspen</td>
</tr>
<tr>
<td>Northern White Cedar</td>
</tr>
<tr>
<td>White Spruce</td>
</tr>
</tbody>
</table>

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  
9.  
10. 
11. 

12. What things helped you learn about trees better? (Circle the option that helped you the most)
What you feel about the nature.

Directions: Now I’d like to find out how you feel about science and nature. Please answer each question to the best of your ability. Circle the number that best describes how you feel. Remember, you can call for the instructor in case you have a question.

13. Do you like to learn about nature? (Circle the option that matches how you feel the most)

Not at all, Sometimes I don’t know, A little, Yes, a Lot

14. If yes, how often do you like to learn about science? (Circle the option that matches how you feel the most)

Not at all, Sometimes I don’t know, A little, Yes, a lot

15. How often do you play outside when the weather permits? (Circle the option that matches how you feel the most)
16. I like to be outside in nature. (Circle the option that matches how you feel the most)

- Not at all
- Sometimes
- I don't know
- A little
- Yes, a lot

17. About how much time do you spend reading or watching videos about the environment every month? (Circle the option that matches how you feel the most)

- Never per month
- Once per month
- Twice per month
- Once per week
- More than twice a week

18. Do you like to be out in the forest? (Circle the option that matches how you feel the most)

- Not at all
- Sometimes
- I don't know
- A little
- Yes, a lot

19. Do you ask your friends to go out in nature with you? (Circle the option that matches how you feel the most)

- Not at
- I don't
20. Do you like to be in nature? (Circle the option that matches how you feel the most)

- Not at all
- Sometimes
- Know
- A little
- Yes, a lot

- Not at all
- Sometimes
- Know
- A little
- Yes, a lot