Children's Attitudes, Behaviors, and Comprehension While Using iPads in Outdoor Environmental Education Programs

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Abstract

In today's digital age children have developed to think and process information differently due to their constant exposure to digital technologies. Educators in the classroom are finding digital technologies, such as mobile devices, to be an appropriate and effective means to present information. Little research has been conducted on impacts that these digital technologies might have in the outdoor classroom. This exploratory study aimed to understand how the emerging uses of digital technology, specifically iPads, impact the learning experiences of children during outdoor environmental education programs. iPads were integrated into nature-based water quality programs based on a theory of social constructivism. Collected qualitative observational data were analyzed through grounded theory coding techniques exploring the attitudes, behaviors and comprehension of fifth grade students while using iPads in nature-based programs. Emergent themes showed student reactions to mobile devices highlighting the "newness" of the devices to many of the students. Themes documented appropriate introduction techniques displaying a clear difference between the comfort level and use of mobile devices by digital immigrants and digital natives. Themes also revealed how students chose to use mobile devices when given the opportunity and how these devices were used specifically for learning. The data revealed few negative impacts of digital technology integration based on the children's attitudes, behaviors, and perceived comprehension. This study offers new insights into how children interact with nature while using digital technology, specifically iPads, in environmental education programs and makes recommendations for best practices for digital technology integration.

I dedicate this thesis to my father, Chris Kacoroski, for supporting all of my genius ideas and encouraging me to reach for the stars while doing so.

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Chapter 1: Introduction

The purpose of the research described in this thesis is to understand how the emerging use of digital technologies, specifically mobile devices, impacts the learning experiences of children during outdoor environmental education programs. This study will document children's attitudes, behaviors, and comprehension while using digital technologies in outdoor environmental education programs to offer new insights as to how children connect with nature.

Digital technology in the 21st century has become an essential part of our daily lives. In today's age, the digital age, children grow up spending their entire lives constantly exposed to digital technologies (Prensky, 2001a). As a result of this constant interaction with various forms of digital technology a child's brain has developed to think and process information differently. Their brains now prefer to multi task, and access information in a quick and random process, creating a hypertext mind that leaps from thought to thought. This has led a child's cognitive structures to seem parallel and not structural, processing information similar to the digital technologies that they have been exposed to function.

Marc Prensky defines today's children as *Digital Natives* as they are considered to be native speakers of the digital language of computers, video games, multimedia, and the Internet (Prensky, 2001a). In the classroom, some educators have chosen to incorporate various forms of digital technology in order to best educate and meet the learning styles of their students. The integration of digital technologies allows an educator to present information through a means that can better connect with the structural thought process of a digital native. These educators, and other adults, who are interested in digital technologies are what Presnky defines as *Digital Immigrants* as they were born before the use of digital technologies became common, but are fascinated by and willing to adapt to using these technologies (Prensky, 2001a).

With the introduction of digital technologies as aids in the classroom, environmental educators are being forced to change their previous ideas about the role of digital technologies in the outdoor classroom and in environmental education programs. Environmental education programs are often in an outdoor setting, providing a holistic educational experience that teaches not only facts to develop environmental awareness and literacy in students, but also encourages problem solving, self-exploration, and personal development (NAAEE, 2011).

Stephen Kellert suggests that nature influences are strongly connected to three types of childhood development: (1) cognitive or intellectual, (2) affective or emotional, as well as (3) evaluative or moral development (2005). Children connect in nature through direct experiences that target their sensory practices (James & Bixler, 2008). Over time, it is a child's first sensory impressions that will give way to perceived regularities and differences in their experience, and as a result create a richer understanding (Brody, 2005). These understandings allow children to learn and grow developmentally.

Along with positive developmental influences, children have proven to be more cognitively focused through their engagement with the natural world. Engaging with nature has shown to be one of the most powerful ways to support investigative processes requiring focused attention such as observation, experimentation, data collection, prediction, analysis, and discovery reporting (Torquati, Gabriel, & Jones-Branch, 2010). It has also been suggested that nature supports creativity and problem solving, enhances cognitive abilities, increases physical activity, reduces stress and symptoms of Attention Deficiency Disorder, and improves academic performance, nutrition, eyesight, social relationships, as well as self-discipline (Nature Learning Initiative, 2012).

By integrating digital technologies into nature-based education programs, some environmental educators are concerned that these digital technologies will no longer allow children to create strong and valuable connections to nature that are important for their development. Other environmental educators, believe that digital technologies are an appropriate and effective way to connect children to the natural world. Digital technologies can provide quick information in a manner that is parallel to how children think and process information today (Prensky, 2001b). These digital technologies provide additional tools to enhance a child's learning, support efforts to appeal to different learning styles, and can create a multidisciplinary approach to learning (Wolf, 2003). By using digital technologies educators are able to provide a more in depth learning experience for a child, as well as enable them to create a greater understanding of the natural world processes.

Importance of the Study

Currently, there is limited research that highlights digital technologies in environmental education (Ardoin, Clark, & Kelsey, 2012). In 2012, Ardoin et al. conducted a study exploring future trends and needs for research in environmental education.

> Whether the interviewees personally feared the impact of digital media as disconnecting people from experiences with nature, or whether they welcomed the opportunities for heightened engagement that such media brings, interviewees shared widespread agreement on the importance of this research. (Ardoin et al., 2012, p. 14).

Some nature centers, residential environmental education facilities, camps, and other organizations that focus on teaching environmental education have started to incorporate various forms of digital technology into their programs in hopes of connecting today's children, digital natives, to nature. To determine the beliefs of non-formal educators and how they chose to use digital technologies, Peffer and Bodzin (2013) surveyed educators in the U.S., Canada, Australia, Japan, South Africa, and Turkey. Of the 406 respondents, 78.6% said that they use a form of digital technology to assist with their environmental education programs. Examples of a few of these technologies were; computers, mobile handheld devices, and GPS Units. Many respondents indicated that they recognize the potential enhancement to their programs but were concerned that using digital technologies would decrease their participant's emotional connection to nature. Several participants did express interest though in learning how they could possibly incorporate other forms of digital technology into future programs.

Research Question

How does the use of mobile devices impact children's attitudes, behaviors, and comprehension during an outdoor environmental education programs?

- **Problem #1:** Document common attitudes of children during outdoor environmental education programs while using iPads.
- **Problem #2:** Document common behaviors of children during outdoor environmental education programs while using iPads.
- **Problem #3:** Determine children's comprehension during outdoor environmental education programs while using iPads.

Limitations

This study is designed to follow a Grounded Theory approach to collection and analysis of data (Patton, 2002). Due to time limitations, this study is unable to fully follow a Grounded Theory approach which requires comparison of multiple datasets in order to develop a complete theory. Also due to time limitations, this study was conducted at only one site and all collected data was solely analyzed by the researcher.

This study is limited to 5th grade students participating in the River Connections program at Riveredge Nature Center during the spring and fall of 2014. This study is further limited to programs that the researcher was specifically able to observe due to logistics and time conflicts.

Chapter 2: Review of Literature

The purpose of this study was to determine how the use of mobile devices impact children’s attitudes, behaviors, and comprehension during outdoor environmental education programs. This chapter will review literature related to use of technology in environmental education. The literature is divided into four sections that focus on: (1) Learning potential of children using digital technology, (2) Digital technology integration based on constructivism (3) Digital technology in outdoor environmental education programs, and (4) Mobile devices in outdoor environmental education programs.

Learning Potential of Children using Digital Technology

In today’s society a child’s brain is constantly exposed to digital technologies causing their brains to develop to think and process information differently. A child’s brain prefers to multi task, and access information in a quick and random process (Prensky, 2001b). Creating a hypertext mind that leaps from thought to thought, which leads their cognitive structures to seem parallel and not structural, functioning similarly too many digital technologies (Prensky, 2001b). As a result digital technologies have become popular instruments in the classroom to foster learning and create educational experiences.

Educators are aware that each child learns differently. When using digital technologies educators can teach to multiple learning styles and increase motivation to learn (Holloway & Mahan, 2012). Digital technologies that are common educational instruments include microscopes, computers, movies, ebooks, mobile device applications, and more. Educators can choose to use multiple digital technologies in their presentation of information to create a holistic approach to understanding the world (Holloway & Mahan, 2012). Digital technologies also allow for 24/7 access to information, enabling greater opportunity for learning in and out of the classroom (Looi, Zhang, Chen, Seow, Chia, Norrist, & Soloway, 2011).

Digital technologies have proven to create engagement in learning, improved behaviors and attitudes, as well as advancement of a child's understanding of material (Wolf, 2003). Using digital technologies as educational instruments create potential for learning by providing the metacognitive scaffolds required to support mindful investigation and facilitate collaborative opportunities (Kim, Hannafin, & Bryan, 2007). Educators have noticed that when they use digital technologies to teach, the students are engaged in their learning and ask meaningful questions that can create valuable learning experiences. Matching digital technologies to student inquiry activities allows children to quickly understand concepts and have discussions before fully grasping scientific or technical terms (Hung, Lin, & Hwang, 2005). Due to this, children are often able to develop stronger personal connections to larger concepts or research.

Limited research has been conducted on digital technology integration into the field of environmental education, though educators hope that by using these instruments they can "foster outdoor experiences that promote learning" (Holloway & Mahan, 2012, p. 24). Integrating digital technologies into environmental education programs have been shown as appropriate educational instruments for enabling children to understand concepts that are often too difficult or complex for them to comprehend by connecting through a means that meets their learning needs and styles (Wolf, 2003).

Recently, a new form of learning has begun to emerge due to the popular integration of digital technologies into the educational field. M-learning or mobile learning was originally developed as a subset of E-learning, also known as internet based learning, though many now believe that M-learning is something entirely different. M-learning is “any educational provision where the sole or dominate technologies are handheld or palmtop devices” (Traxler, 2005). M-learning enables a student to learn in various settings while being mobile.

In one study researchers reviewed the current pedagogical learning strategies being applied to M-Learning environments. In their review they found that the M-Learning model was focused on connections between “mobile user, learning strategies, situated environments, and virtual group awareness” (Jeng, Huang, Tan, & Yang, 2010, p.8). They also found that m-learning was able to aid in creating a knowledge context that pertained to learners’ lives. The researchers make a strong case for M-Learning by stating: “Mobile technology does not aim to complicate learning process but facilitate mobile learners’ learning process. To create new innovative learning opportunities, one needs to take into account the usability and the rationality” (Jeng et al., 2010, p.8). Another study chose to evaluate different m-learning projects exploring the impact of iPad integration (Cochrane, Narayan, & Oldfeld, 2013). iPads were integrated into thirty-five university course projects over the span of four years and used as platforms for learning. Researchers found iPads to be powerful instruments for collaborative use, enabling a higher level of student interaction and engagement, and supporting a social constructivist model enabling students to work collaboratively to complete assigned tasks. Researchers also found iPads to be efficient content generation platforms that allowed for a more flexible learning environment.

Digital Technology Integration Based on Constructivism

As educators, in and out of the traditional classroom, increase their use of digital technologies to meet the needs of their students, they are required to adapt their teaching styles in order to appropriately integrate these new educational instruments. For many the integration of digital technologies neatly fits into a constructivist approach to learning.

Constructivism is based on the idea that a student comes to a class with a particular wealth of knowledge, skills, and experiences that create their personal perception (Ozer, 2004). This theory believes that it is the responsibility of the educator to further foster the student's learning by building upon their pre-existing knowledge. This is done by giving the student a tool or instrument so that they can construct or create their own meaning (Oliver & Herrington, 2003). By integrating digital technologies into education, the device becomes the instrument in a goal-based scenario that encourages the student to develop his or her understanding of various scientific concepts (Cox & Cox, 2009).

For this study, a social constructivism model was specifically chosen to integrate mobile devices into outdoor environmental education programs. Lev Vygotsky's theory of social constructivism believes that children develop cognitively through social activities and education (Ozer, 2004). A child learns by first making a connection to a social environment on an interpersonal level and then later internalizing it to create meaning (Ozer, 2004). His theory stresses discovery through social interactions with other students and teachers while in a class setting (Ozer, 2004).

Social constructivism utilizes activities with multiple solutions that require students to build not just on their own prior knowledge but also on their common interests and experiences with other classmates, creating a collaborative learning experience that requires the students to work together (Bonk & Cunningham, 1998). Often the learning environment closely reflects real-world situations demanding deeper knowledge and skills of the students, further encouraging collaboration. The educator's main responsibility is to provide learning guidance and direction but the majority of the learning is left in the control of each student (Bonk & Cunningham, 1998).

M-Learning or mobile learning utilizes mobile devices with assumptions that it allows a learner to move from physical location to physical location and enables the learner to actively control his or her own education (Thinley, Geva, & Reye, 2014). With this flexibility learners are encouraged to interact with others to create and construct meaning from educational content. In social constructivism, learners are encouraged to do the same and it is through these interactions that students are able to test ideas, skills, problem solve, and build deeper understandings (Thinley et al., 2014).

A study focusing on how pre-service teachers use mobile devices to facilitate learning found that pre-service teachers chose to use mobile devices in four ways: understanding of content, understanding of pedagogy, staying connected, and staying organized. The study highlights how these uses closely align with social constructivism and explains how pre-service teachers' use mobile devices to improve their learning as well as their students, enhancing overall learning through shared meaning with others (Pegrum, Howitt, & Striepe, 2013).

The challenge for environmental educators is to integrate digital technologies into their programs in a way that does not distract from a child's connection to nature, as these connections are extremely important for his or her development. In following a social constructivism-based theory by using digital technologies as education instruments with the sole purpose to further advance the student's knowledge, a balance between digital technologies and nature has the potential of being obtained. Since the idea of using digital technologies in environmental education programs is fairly new there is no research specifically focusing on a constructivism approach to integration in outdoor environmental education programs. In this study the goal is to integrate mobile devices based on a philosophy of social constructivism encouraging students to learn collaboratively through social environments.

Digital Technology in Outdoor Environmental Education Programs

It is important that the integration of digital technologies not detract from the educational learning environment and outdoor program. To many, environmental education programs are considered participatory learning environments. A study utilizing GIS technology to engage students in urban environmental learning demonstrated how digital technologies can be beneficial in participatory learning environments (Barnett, Vaughn, Strauss, & Cotter, 2011). In this study, participatory learning environments were defined as having five characteristics:

> (1) designed to engage learners in authentic science; (2) learners should be engaged in the 'making-of-science' and not simply memorizing a set of readymade knowledge; (3) learners should be engaged in participatory science learning activities with others who have less, similar, and more experience and

> expertise than themselves; (4) learners should not be completing the task for some reward but should be working towards addressing a real-world need that they have identified as important; and (5) learners should be given the opportunity to participate in a professional community (Barnett et al., 2011, p. 201).

Results of the study show that students improved their “ecological mindset” and their “science self-efficacy” with the integration of digital technologies.

Another study chose to experiment with integration of remotely operated vehicles (ROVs), an instrument designed similar to a small underwater submarine with camera capabilities, in environmental education programs. The study was conducted in the great lakes region, allowing participants in programs to explore and learn about underwater ecosystems. The researchers hoped to determine the reaction of both adults and children to digital technology integration into outdoor programming, as well as their connection to nature while using the ROV (Harmon & Gleason, 2009). The study showed that 83% felt that their educational experience was in some way impacted by using the ROV, and of this 83%, the overall consensus was a positive experience stating that the ROV allowed them to explore a marine environment in a more creative, exciting, and educational way. Those few participants that responded negatively to the ROVs explained that they found the ROV to be stressful or boring.

Similarly, the United States Forest Service chose to conduct an exploratory study to determine if outdoor activities were enhanced with the addition of digital technologies. The study was conducted as a part of Youth Day event where two activities were designed technology independent and two other activities, that were on similar topics, were designed as technology dependent (Chavez, 2009). Activities were designed as interactive experiences connecting children with nature. The technology dependent activities utilized GPS units or cameras as a means to connect children to nature. The majority of responses from the children expressed that all of the activities were “cool” or “rocked”, though over 10% more voted for activities that were technology dependent than those that were technology independent. Observations of the children noted that those children involved in the technology dependent activities seemed to show greater interest and excitement, explaining to observers that these activities were fun.

Digital technologies have become popular instruments to further foster learning in outdoor programs with countless educators across the world experimenting in appropriate integration techniques. The hope is to develop a technique for integration that does not negatively impact a participant’s connection to or engagement with nature during a program.

Mobile Devices in Outdoor Environmental Education Programs

The use of specifically mobile devices or similar m-learning devices in educational settings have become popular as these devices become more common and less expensive, even though currently few environmental education organizations utilize these instruments in their programming. A study by Goundar (2011) exploring the potential impact of mobile devices in indoor education programs provides insights to possible impacts in outdoor environmental education programs. Mobile devices, especially when they are touch screen enabled, were shown to be an exciting way for children to interact with technology. Children participating in the study appeared to love being able to hold, explore, and play with the devices. The devices appeared to contain the potential for connecting children struggling in class due to learning disabilities by meeting the needs of individuals. The study also noted a few possible problems using mobile devices in educational programs including; the infrastructure, the technology, and the content/curators. Mobile devices require regular maintenance requiring additional time, as well as a certain amount of care in regards to treatment which can occasionally be a challenge for children

Another study used a similar device, though less advanced, form of technology called a Personal Digital Assistant or PDA with a WiFi based wireless network card in order to engage students in bird-watching activities (Chen, Kao, Sheu, & Chiang, 2003). The researchers stated that, “with the trend of the educational media becoming more mobilized, portable, and individualized, the learning form is being changed dramatically”, and as a result chose to explore the possibilities that a mobile device might contain for outdoor education (Chen et al., 2003, p. 1). Mobile digital technologies were able to deliver information based on a learner’s request providing the ability to learn at any time or in anyplace, embedding learning into daily life. The study found that mobile digital technologies were appropriate educational instruments to connect learners to immediate problem solving skills and knowledge. The capabilities of the mobile devices were also able to involve various learning styles, meeting the learning needs of a wider range of students. It was found at the end of the study that participants who used the program and device improved their learning beyond what would have normally been expected.

A study with a slightly different research focus choose to use an application called SketchMap on a PC Tablet with a GPS and camera to understand how children could use mobile digital technologies to share outdoor learning experiences (Sugimoto, Ravasio, & Enjoji, 2006). In this study, 80 fourth graders were split into groups and given a task to create maps of their outdoor experience exploring nature that could later be shared with their peers. Educators commented that the students had no problems using the device and appeared to be more engaged in the lesson. Also during the discussion, conversations among students showed that having the capabilities to share their outdoor experiences were useful in their collaborative learning processes.

A more recent study looked at how children learned science using mobile devices as educational instruments (Looi et al., 2011). In this study, a third grade class's science curriculum was delivered via mobile digital technologies, specifically HTC Smartphones. Each student was given his or her own device, enabling a 1:1 contact with the device 24/7. A majority of the students felt that the devices were easy to use. Eighty percent of the students thought that the device helped them to learn both in and out of classroom, providing a way to connect their learning to their daily lives. Researchers observed that students were more engaged in the science material and were able to make personal connections to concepts, fostering further thinking and research of their own.

A final study, aimed to develop new uses for digital technologies in environmental education lessons by specifically understanding students' feeling of connection to, engagement with, and understand of nature (Workman & Hatzenbihler, 2014). iPads and other digital technologies were integrated into six different environmental education programs. Students participating in the study were divided into experimental and control groups to experience programs with and without digital technologies. Researchers found that students using mobile technologies were “more interested in interacting with nature as part of school” and “interested in using the tools and equipment used in this program in school activities” showing that students were interested in using digital technologies for educational purposes (Workman & Hatzenbihler, 2014, p. 1).

The application chosen for this study, the Water Quality app, is an application that was designed as a data collection database to foster learning during and after programming (Kerlin, Kannan, Mayfield, 2012). The application was tested for educational potential in outdoor environmental education programs prior to this study in 2012. The pilot test indicated that the Water Quality app was easy for students to use and can be used to extend learning beyond the site visit through data analysis back in the classroom. The app also appeared to engage students in water quality activities that were more interested in technology and were “shy about getting dirty”, creating connections to nature for students who would normally be disengaged (Kerlin & Herman, 2013). The articles above suggest that digital technology is beneficial in outdoor environmental education programs for various reasons. The research reported in this thesis looks directly at children’s attitudes, behaviors, and comprehension of material while using iPads in water quality based outdoor programs.

Chapter 3: Methods

The purpose of this study was to determine how the use of mobile devices impact children's attitudes, behaviors, and comprehension during outdoor environmental education programs. This study followed a grounded theory approach to collecting and analyzing qualitative and quantitative data. Qualitative data, in the form of observational program notes, documented children's interactions with mobile devices during programs. Quantitative data, collected from the mobile devices, described student use of the devices. Collected data were evaluated to determine how mobile devices are used by children while participating in outdoor environmental education programs. Collected data were further assessed to understand the role of digital technologies as educational instruments to further foster learning.

Study Approval

Following University of Wisconsin-Stevens Point research protocols, this study was reviewed and approved by the Institutional Review Board for the Protection of Human Subjects. Based upon the board's request, all adults teaching selected programs were contacted prior to the start of data collection. These adults were asked to sign consent forms confirming their willingness to participate. This was decided as visitors of all ages participate in programs at the Riveredge Nature Center while many more visitors recreate on their property on a daily basis. Also all data was collected anonymously, no part of the observed programs were changed or altered as a result of this study and there were no interactions between program participants and observer. A reproduced example of the consent form can be found in Appendix B.

Research Design and Methodology

This study collected both qualitative and quantitative data, though quantitative data were only used to support qualitative codes and calculate program numbers. Qualitative research methods are used by social scientists to explain or understand the "how" of "how people make sense of their world and the experiences that they have in the world" (Merriam, 2009 p.13). Collected data sets are expressed as information in words (Riddick & Russell, 2008). In a qualitative study, the researcher is the primary instrument focusing on the meanings and understanding that emerge from data (Merriam, 2009). This study specifically followed a Grounded Theory approach to collecting and analyzing data. Grounded theory is qualitative inquiry research that aims to create rather than test existing theory, and is a process of creating a theory that utilizes a constant comparison method (Patton, 2002). This means that data are collected and compared at multiple sites through theoretical sampling and tested for emergent concepts with further data. Due to limitations and size of the study, this research is only one step in the process of creating a theory with the hopes of further research building upon results.

Quantitative research is different from qualitative research, as it focuses not on "how" but instead on the measurement of "what" (Riddick & Russell, 2008). Quantitative sets of data are collected and expressed as numerical values, which allow the researcher to evaluate data based off of comparisons. Categories in quantitative research are the following: descriptive, explorative, evaluative, predictive, explanatory, and controlled (Black, 1999). This descriptive study utilized quantitative counts to support qualitative themes.

Program Description

This study was conducted as a part of the pre-existing River Connection program at Riveredge Nature Center in Saukville, Wisconsin. The River Connection program was designed through a partnership program between Riveredge Nature Center and Urban Ecology Center in Milwaukee, Wisconsin. The program was created as an opportunity for fifth grade students from the greater Milwaukee region to learn and test water quality along the Milwaukee River in a rural as well as urban setting.

Six mobile devices used for the study were owned by the Wisconsin Center for Environmental Education. The devices were purchased through a university technology grant to be used in campus environmental education and natural resource undergraduate courses as well as for purposes of this study and future related studies.

In total, nine programs were selected to be observed between May and October of 2014. Students arrived each morning at Riveredge Nature Center and spent the first half of the morning learning about watersheds and the importance of good water quality. Students were then split into groups of three or four and spent the second half of the morning collecting macro-invertebrates in the Milwaukee River. After lunch, students were asked to select one macro-invertebrate each to identify and draw. Students were then instructed to identify all of the macro-invertebrates in their buckets and record their data. Normally, during a River Connection program students would record data on individual worksheets. For purposes of the study, mobile devices were integrated into the River Connection program to replace the worksheet and students were asked to enter data into the Water Quality app.

The Water Quality app was created in 2012 by a team of science education, biology and informatics faculty, staff and students from Northern Kentucky University and the Foundation for Ohio River Education (Kerlin, Kannan, & Mayfield, 2012). The app is designed as an interactive water quality lab report and K-16 learning tool. Data can be recorded in the app as an interactive laboratory report. Data to be recorded include weather, pH, Dissolved Oxygen, Turbidity, many other chemical, physical and biological parameters as well as collected macro-invertebrates (Figure 3.1 and Figure 3.2).

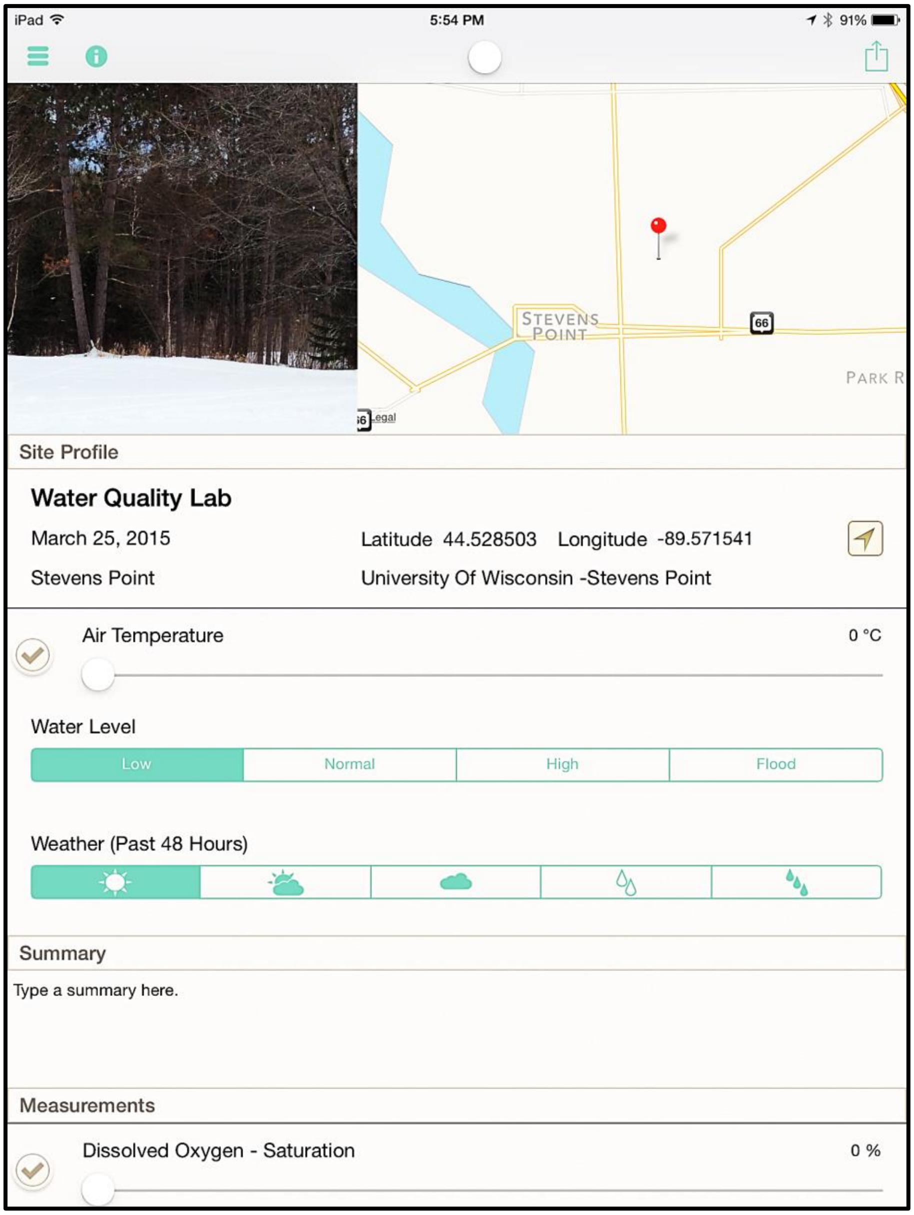

Figure 3.1 – Water Quality App Lab Report. An interactive lab report designed as an app and used by students to collect data.

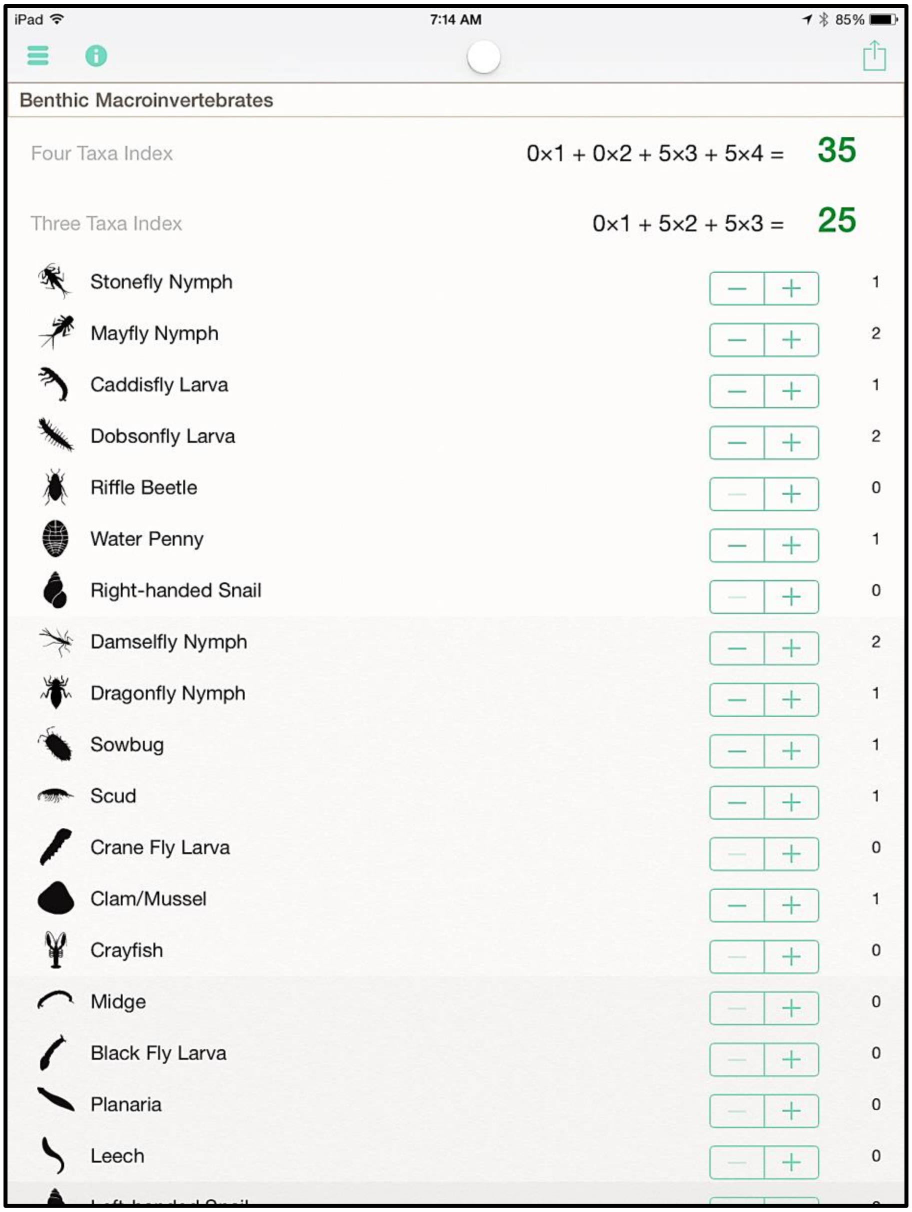

Figure 3.2 – Water Quality App Macro-invertebrate, the macro-invertebrate section of the lab report. This section of the lab report was the main program focus.

Information explaining data can be viewed by pressing on a particular data entry. For example, by pushing on a macro-invertebrate's name as viewed in Figure 3.2 information of the macro-invertebrate pops up as viewed in Figure 3.3. Students participating in the River Connection program were asked to enter the number of collected and identified macro-invertebrates. The Water Quality app aided students in the identification process as well as provided information about collected macro-invertebrates (Figure 3.3).

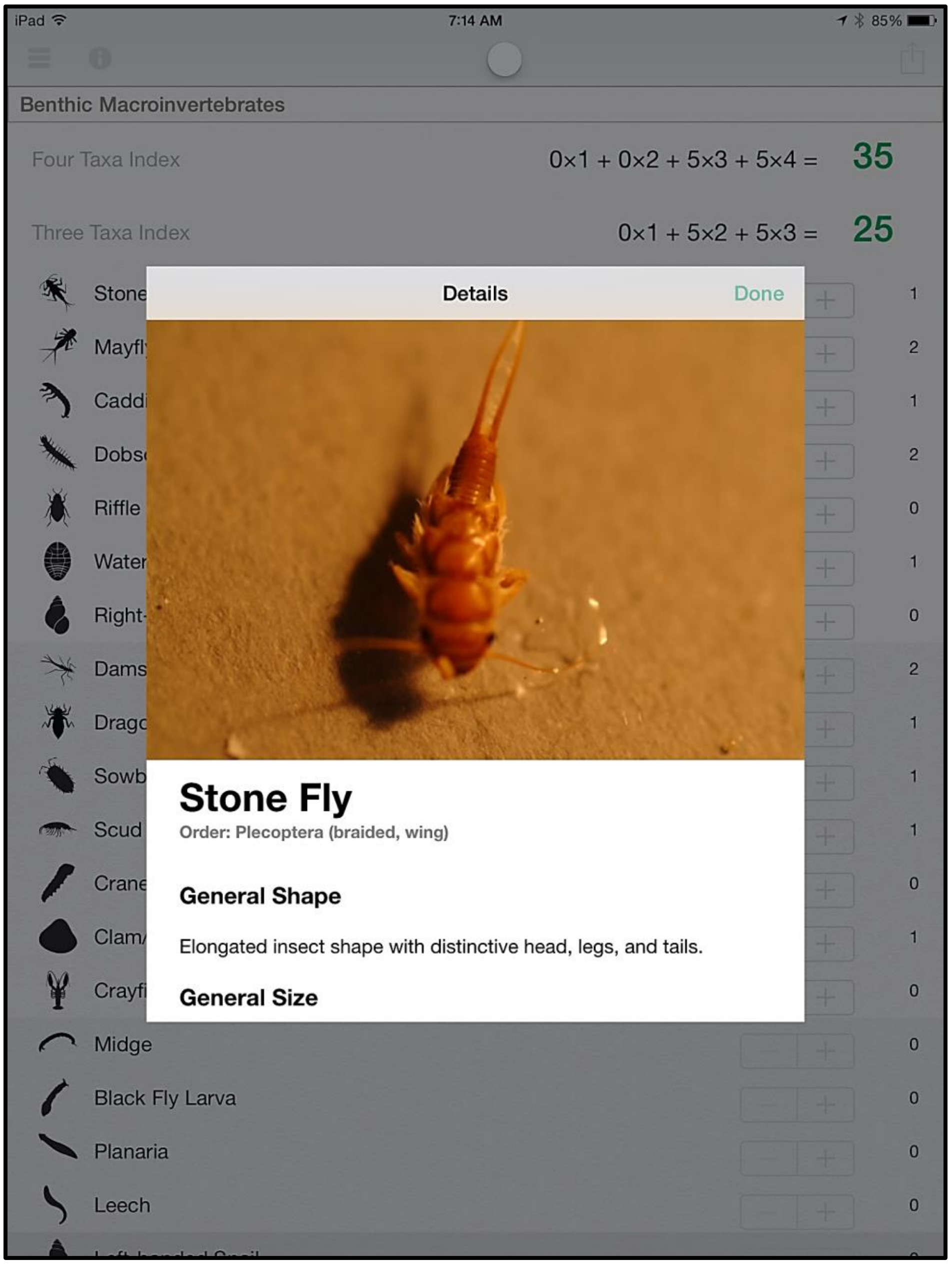

Figure 3.3 – Water Quality Macro-invertebrate Guide. The interactive element providing more information on macro-invertebrates for students.

During the wrap up portion of the River Connection program students were asked to share their list of macro-invertebrates with the entire class. Data were then used to collectively determine water quality through a bio-assessment of the Milwaukee River for that day (Figure 3.4).

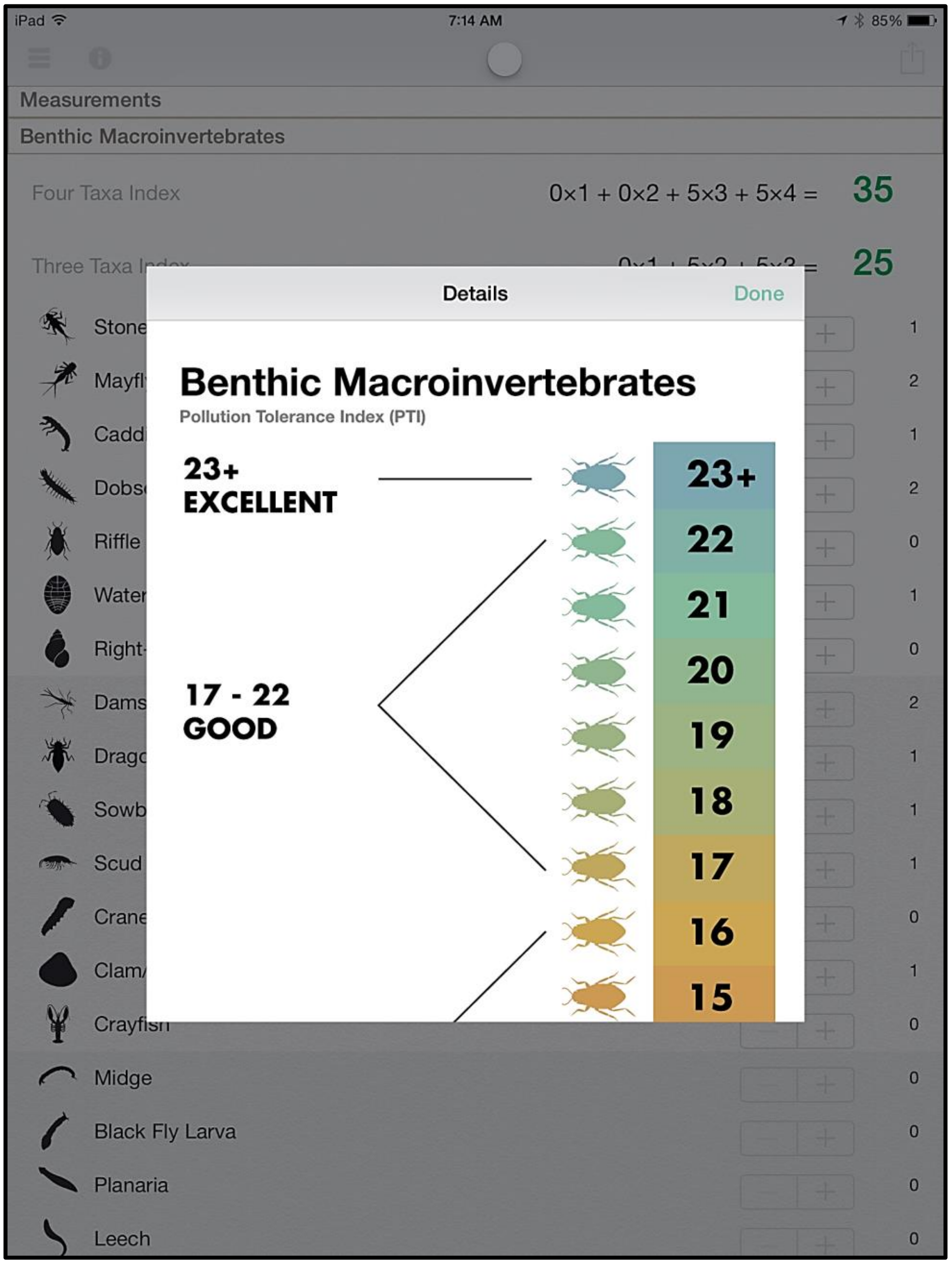

Figure 3.4 – Water Quality App Taxa. The interactive element providing more information on the water quality of the river for students.

Data Collection

Data were collected between May and October of 2014, from nine programs. Observational notes were collected throughout each program. The researcher acted as a non-participatory observer, meaning that there were no interactions with students during observations. Students were observed as an entire class while together and when broken into smaller groups, Group #2 of each class was selected for observation. Notes were recorded and separated based on program sections that separated the duration of the program. Notes documented children's attitudes, behaviors and comprehension in nature while using mobile devices. After each program one page summaries were written by the researcher documenting overall program observations. Data on student use of mobile devices were collected from all devices and recorded in a rubric as well. Refer to Appendix D for an example of the iPad rubric.

Student Demographics

A total of 215 students participated in the observed River Connection programs, and of those 33 students were specifically in Group 2. Students were mostly fifth grade students, ages 10 to 11, from seven different schools. Two observed programs, Program 5 and Program 6, did include some fourth and sixth grade students. This was unknown until after the program. Students participating in Program 5 and Program 6 ages ranged from 9 to 11.

Students participating in observed programs came from the Greater Milwaukee region. All schools were located roughly within a 2 mile radius of each other. On average students traveled approximately 30 miles from the location of their school to Riveredge Nature Center for the programs. Most students participating in programs where from minority populations, mainly African American, Asian, and Latino (Public School Review, 2015).

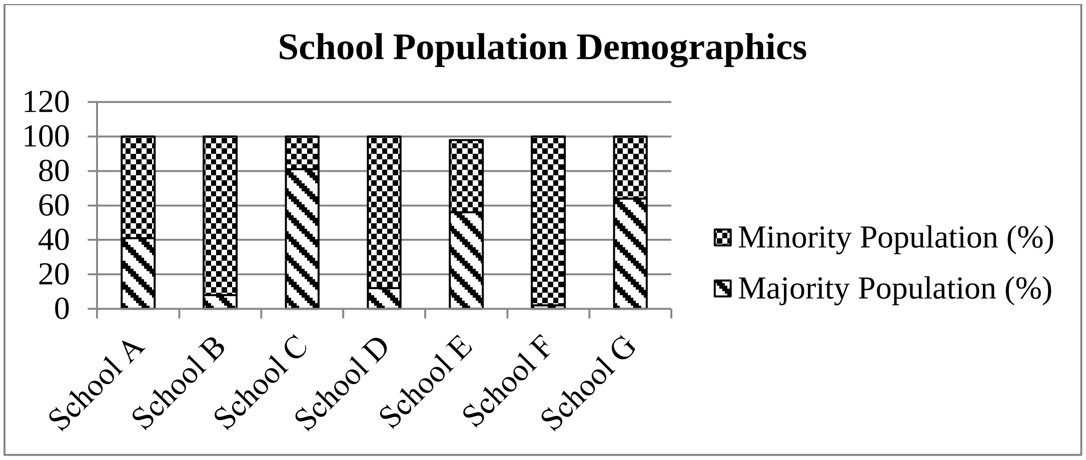

Figure 3.5 – School Population Demographics. Broad population demographics of schools participating in the study.

Table 3.1 - Participating Schools	
School	Program
School A	1
School B	2 and 7
School C	3
School D	4
School E	5 and 6
School F	8
School G	9

Table 3.1 – Which program each school participated in.

Data Analysis

Qualitative data sets were analyzed using NVivo, a platform specifically designed for analyzing unstructured data. NVivo enabled the researcher to separate observational data and identify codes as they emerged. Data were analyzed based on Grounded Theory techniques of “building theory up from the data itself” (Birks and Mills, 2011, pp. 11), meaning that codes were created directly from data and the study was exploratory. Data were coded through a method of open coding to identify important observations. These codes were compiled into categories which were sorted into a framework of themes providing insight into how children interact with mobile devices in outdoor environmental education programs. A constant comparison method of analysis was followed throughout the research process to ensure validity of codes (Glaser & Strauss, 1967).

Emergent Coding Framework

The emergent coding framework developed seven main themes: Reactions to Mobile Devices, Newness Factor, Nature Prevails, Digital Native versus Digital Immigrant, Introduction of Mobile Devices, and Mobile Devices in the Hands of Children and Instruments for Learning. All themes were developed directly from coded data. Emergent codes were used to create sub-themes and sub-themes were used develop themes. For example, the theme “Digital Native vs. Digital Immigrant” was developed by a combination of two categories “Digital Natives Teaching” and “Trusting Students”. The sub-theme “Digital Natives Teaching” was created from three original codes; “iPad Behaviors” “Positive Engagement” and “Digital Native”. The sub-theme “Trusting Students” was created from two original codes “Educators” and “Adult Intervention”. Table 3.2 shows the development of all seven themes based on sub-theme and codes. Definitions of codes can be found in Appendix C.

Table 3.2 – Emergent Code Framework		
Themes	Sub-themes	Codes
Reaction to Mobile Device	Student Reactions	iPad Learning Interest Specific Pro iPad iPad Attitudes Initial Device Reaction Neutral iPad iPad Interest iPad Attitudes Initial Device Reaction iPad Curiosity
Newness Factor	Problems Sharing	iPad Behaviors Negative Engagement Problems Sharing
	Student Reactions	iPad Behaviors Positive Engagement Newness
Nature Prevails	Nature Trumps	iPad Attitudes Con iPad Nature Trump Trump iPad Time
Digital Natives vs. Digital Immigrants	Digital Natives Teaching	iPad Behaviors Positive Engagement
	Trusting Students	Digital Native Educators Adult Intervention of iPad
Introduction of Mobile Devices	Effective Introduction	Educators iPad Instruction Effective Instruction
	Ineffective Introduction	Educators iPad Instruction Ineffective Instruction
Mobile Devices in the Hands of Children	Handling of iPads	Respectful Use of iPads Disrespect Handling iPads
Instruments for Learning	Effective Learning Tools	iPad Behaviors Positive Engagement Demonstrated Learning iPad Behaviors Positive Engagement Collaborative Use iPad Attitudes Pro iPad

		iPad Learning Interest
		Specific
	Ineffective Learning Tools	iPad Behaviors
		Negative Engagement
		Not Appropriate Learning
		iPad Behaviors
		Negative Engagement
		Distraction Caused
		iPad Behaviors
		Negative Engagement
		Confusion
		iPad Attitudes
		Con iPad
		iPad Disinterest
		Neutral iPad
	Sharing Information	iPad Behaviors
		Positive Engagement
		Sharing Info

Figure 3.2 – The emergent code framework developed through analysis of data.

Due to close relationships among data, a single code often provided important insight to multiple themes.

Trustworthiness

All research needs to be trustworthy or valid though it is important to note that this is a goal to be achieved and not an inherent product (Merriam, 2009). Ensuring that research is trustworthy refers to “whether what you are observing, identifying, or measuring is what you say” (Boyman, 2001 p. 270). Establishing credibility, transferability, dependability, and confirmability are all ways for a researcher to do this (Lincoln & Guba, 1985). These four categories address similar categories in quantitative research such as internal validity, external validity, reliability, and objectivity.

Each of these categories has a slightly different focus; together they create overall trustworthiness in a study. Credibility displays confidence in the “truth” of the researcher’s findings. Transferability shows that the findings are applicable in other contexts. Dependability demonstrates that the findings are consistent throughout the study and could be repeated. And confirmability outlines the extent to which the findings are influenced by the researcher’s own biases and the methods that the researcher took to achieve neutrality of data. The researcher was able to establish trustworthiness in this study by addressing six of the thirteen recommended techniques outlined by Lincoln and Guba (1985): prolonged engagement, persistent observations, peer debriefing, thick descriptions, external auditing, and creation of an audit trail.

Prolonged engagement is when the researcher spends a sufficient amount of time at the research site learning about the culture, social setting, and other factors related to their research. Prolonged engagement requires the researcher to spend time creating relationships with members of the community, speaking with a wide range of individuals. In this study, the researcher was able to engage in prolonged engagement by spending additional time at Riveredge Nature Center working closely with nature center staff to assess and ensure their comfort with using mobile devices and being a part of the research process.

Persistent observation is closely connected to prolonged engagement, providing depth to the engagement. Persistent observations occur during prolonged engagement when the researcher identifies characteristics and elements that are most relevant to the research question and focuses on them in detail. In this study, the researcher was able to achieve persistent observation through prolonged engagement with Riveredge Nature Center, the River Connection program, experimentation and use of the Water Quality application, and targeted reviews of relevant literature. During engagement with these topics the researcher was able to identify relevant characteristics and elements relating to the research question.

Peer Debriefing is a process when the researcher exposes oneself to a wide range of peers “for the purpose of exploring aspects of the inquiry that might otherwise remain only implicitly within the inquirer’s mind” (Lincoln & Guba, 1985, p. 308). After each observed program the researcher took the time to casually talk with educators, asking for his or her own perspective of the program. Many educators were initially very hesitant to integrate mobile devices into the programs, often creating a different perspective for the researcher to consider before writing summative program notes.

Thick descriptions in notes add additional trustworthiness to the data and facilitate analysis. In this study, the researcher was very conscientious about writing thick descriptions when observing programs so that as much detail would be included as possible.

External audits, also called inquiry or confirmablity audits, require another skilled researcher to become involved in the research process and to examine both the procedure and product. In doing so, the study is evaluated for accuracy of procedure, interpretation, and conclusion. In this study, the main researcher consulted with three other external researchers to determine appropriate research procedures as well as evaluate analyzed data.

Audit Trails outline the steps of the study from start to end. Documentation of this study’s steps has been recorded in the form of this thesis. Further detailed notes documenting the study’s steps have been saved by the researcher.

Other criteria to establish trustworthiness were unable to be achieved due to research related logistics. For example, the researcher originally hoped to establish trustworthiness by triangulating program observation notes, iPad use reports, and student questionnaires. This proved to be unfeasible due to time constraints and restrictions set in place by the Institutional Review Board for the Protection of Human Subjects. The researcher was only able to collect program observation notes and iPad use reports, along with the addition of summative program notes. These three forms of data do not create the depth of information that student questionnaires might have added to the study through triangulation but allowed the researcher to create connections within the data.

Chapter 4: Results

The purpose of this study was to determine children's attitudes, behaviors, and comprehension while using mobile devices in outdoor environmental education programs. Of the 33 students who participated in Group 2 during the nine programs, 23 students used a device for a significant period of time (Table 4.1).

Table 4.1 - Student Use of Mobile Devices

Program Number	**Group 2 Students Using Mobile Device (n)**	**Group 2 Students Not Using Mobile Device (n)**
1	3	1
2	3	1
3	4	0
4	1	2
5	2	1
6	4	0
7	2	2
8	2	1
9	1	3

Note: Uses were both educational as well as non-educational focused. A significant period of time was defined as using a device for a direct purpose instead of quickly glancing at it. This included students who watched group members use mobile devices since they were learning even though they were not directly navigating a device.

There were no apparent differences found between males or females choosing to use mobile devices (Table 4.2).

Table 4.2 - Gender Use of Mobile Devices in Programs

Mobile Device Use	Males (n) 13 participating male students	**Males (%)**	Females (n) 20 participating female students	**Females (%)**
Used Device	9/13	69.23%	14/20	70%
Did Not Use Device	4/13	30.77%	6/20	30%

Results addressing specific sub problems are organized in two sections: Attitudes and Behaviors, and Comprehension.

Attitudes and Behaviors

Altitudinal and behavioral data closely overlapped, creating cross cutting emergent codes which were developed into themes explaining how children use mobile devices in outdoor environmental education programs. There were six categories created from the themes: Reactions to Mobile Devices, Newness Factor, Nature Prevails, Digital Native versus Digital Immigrant, Introduction of Mobile Devices, and Mobile Devices in the Hands of Children.

Reactions to Mobile Devices

Student initial reactions to mobile devices were mainly displayed as excitement and eagerness. In seven of the nine observed programs, upon learning that they were going to be using mobile devices students reacted with gasps of excitement, stated “yes”, along with other similar verbal indicators of interest. Students also demonstrated positive body language such as sudden forward leaning and more focused eye contact as though the introduction of mobile devices had caught their attention. In the other two observed programs, students did not show any noticeable change in attitude or behavior. Their attention was focused on educators as they received activity instructions, occasionally asking for clarification in regards to the overall assignment.

> The students gasp with excitement at being told that they will be using iPads. A few of the students mumble to each other and a few other are heard saying “yes!”

> quietly. The students' lean forward with interest as the educator explains to the students how to use the iPads. (Program 2)

> The educator introduces the iPads. There is no noticeable response from the students. One girl asks how they should separate the macros-invertebrates. The educator answers her question and then continues to explain how to use the iPads. (Program 6)

Despite the majority of students' initial reaction to mobile devices, upon receiving the device at their bucket station many students were observed quickly losing interest in the device or being completely uninterested. Uninterested students were focused on macro-invertebrates in their bucket or were occasionally distracted by other groups.

> Girl grabs iPad from the educator first. Boy goes to grab it from her, but she doesn't give it to him. The other two girls in the group do not pay attention to the iPad, though one of the girls leans over to help enter the passcode. (Program 1)

> Girl takes the iPad and stands close to the educator while she explains how to use the iPad. Girl then takes the iPad back to her station and Boy takes the device from her. He looks through the apps but quickly decides to place it on the wall. He wanders away. The other two girls ignore the iPad and play with the macro-invertebrates in the bucket laughing and giggling. The first girl soon joins them. No one is using the iPad. (Program 5)

Newness Factor

It was assumed that for many of the participating students mobile devices were fairly new. This assumption was made based on students' initial reaction, continuous curiosity, as well as their requests to keep the devices. In four of the nine programs, one or more students asked if they would be able keep a mobile device.

Upon receiving mobile devices, a few students were heard commenting that they were going to keep the device and not share with their group members. Occasionally, one or two group members complained to an adult. In a few cases, adults directly told group members to work together or share the device to complete assigned tasks. Overall, most disagreements in regards to sharing were resolved quickly among individual group members without adult intervention, usually ending with the upset group member giving up and walking away to do something else, such as talk to another group or look in his or her group's bucket of macro-invertebrates.

> Boy, and both Girls are now all looking at the iPad together. Boy asks, "Can I get the iPad?" and then states "You're not sharing the iPad". (Program 1)

> Boy ignores the Educator and continues to hold the iPad. The chaperon takes the iPad from Boy and gives it to Girl. Boy immediately asks if he can have the iPad back. The iPad is passed to the other Girl. She holds the iPad carefully and reads something on it. Boy wanders over to look at the iPad with her. He then becomes distracted by the bucket of macro-invertebrates and looks in there instead. (Program 2)

Nature Prevails

In all nine observed programs there were cases where nature held the attention of students instead of the mobile devices during times when students were supposed to be using devices to record data. Many students were observed poking or talking to macro-invertebrates in their bucket. Occasionally, students did this while using a mobile device but for the most part these actions were without the aid of the device. Macro-invertebrates were also frequently observed attempting to escape from buckets. When this happened all group members, including those using a mobile device, would quickly switch their attention to the escaping macro-invertebrate.

> Boy is still looking into the bucket. He seems to be enjoying himself, smiling and laughing. He screams, apparently two macro-invertebrates are attacking each other. (Program 4)

> Girl ignores the iPad and plays with the macro-invertebrates in the bucket laughing and giggling. Another girl joins her. No one uses the iPad. (Program 5)

> Girl is heard saying “Omg it just moved!” Apparently she is talking about a water penny. The other girl puts down the iPad so that she can look closer into the bucket. (Program 9)

Digital Natives versus Digital Immigrants

The gap between digital natives (majority of students) and digital immigrants (majority of adults), two terms identified by Marc Prensky (2001a), was fairly apparent during observations. Majority of students participating in programs did not have any issues navigating mobile devices no matter the depth of instruction. Students appeared to be able to navigate the devices intuitively, though a few students were observed having some difficulty either opening the protective case on the device or occasionally navigating the Water Quality app. When this happened another student always stepped in first to help instead of an adult.

> One student asks for help from the educator, he can't seem to find a macro-invertebrate on the iPad. Boy leans over to help the student with the question. (Program 4)

A few educators struggled instructing students how to use mobile devices and the Water Quality app which often led to further confusion among teachers and chaperons. Some adults were helpful, aiding and guiding students' learning by keeping them on task, while other adults proved to be more of hindrance, becoming confused on how to use the device. There were multiple incidences were a student was observed showing a confused adult how to use the device correctly, such as opening the case or navigating to the Water Quality app

> A chaperon comes over she is holding an iPad. She asks the group "How do I open this?" Boy takes the iPad from the chaperon without words and opens the case that the iPad is in. He then teaches the chaperon where to go to find the app and shows her how to find the stonefly nymph. (Program 2)

Introduction of Mobile Devices

Introduction of mobile devices was the most effective when educators explained the Water Quality app clearly and concisely. Mobile devices were explained to students as educational tools that were to be use for data identification and collection only. Students were told where and how to enter their data, leaving the majority of instructional time to outlining behavioral expectations. Behavioral expectations were also reiterated multiple times throughout the program to students as continuous reminders to stay on task.

> Educator introduces the iPads the smoothest so far. Her explanation is very short, simple, and to the point. She does not make the iPads out to be a big deal; they are only another tool to record. (Program 4)

> Educator explains that the iPad is another way to learn. He strongly expresses that the students need to be careful while they use the iPads. He tells the students that the devices are tools for learning only. (Program 7)

The introduction of mobile devices became ineffective when educators explained how to use the Water Quality app in great detail. When the app was fully explained students quickly became distracted and little attention was given during the full duration of the explanation. Students were observed looking elsewhere distractedly, playing games, or talking to each other. Instruction and introduction of mobile devices also became ineffective when adults (chaperons, teachers, and educators) demonstrated signs of uncertainty or discomfort while explaining to the students how to correctly use the devices. The lack of confidence while explaining the mobile devices and Water Quality app led some students, as well as other adults, to become confused.

> Extra time was spent going through the app and explaining how it worked. Students seem distracted or bored during this time and it was hard for the educators to keep their attention. (Program 1)

> Educators had a hard time working the devices to show the students what they were going to be doing. The educators chose to spend a fair amount of time introducing the parts of the app to the students though when the students got to use the iPads most of the educators/teachers/chaperons were confused as to how to work the devices and the students show no difficulty. (Program 2)

On some occasions educators told students about the pop up function in the Water Quality app, but there were also cases where educators left this instruction out completely. During programs where educators neglected to explain the pop up function to the students, students were observed discovering it on their own.

Mobile devices were effectively introduced in five of the nine programs and ineffectively introduced in four of the nine programs.

Table 4.3 - Program Introduction		
Program Number	**Effectively Introduced**	**Ineffectively Introduced**
1		X
2		X
3		X
4	X	
5		X
6	X	
7	X	
8	X	
9	X	

Note: Programs were determined as effectively introduced or ineffectively introduced based on coded observational data.

Mobile Devices in the Hands of Children

There were no incidences of targeted disrespect towards mobile devices in any of the programs. While using a mobile device a student's attention was completely absorbed in the activity, face close to the device as he or she looked at information. During the macro-invertebrate identification section of the program students were observed handling mobile devices with care, often holding them close to their bodies or cradling them with two hands. Occasionally, a student did choose to run with one of the devices but while doing so he or she grasped the device tightly. Mobile devices were either carefully handed between group members or placed on the stone wall when not in use. When left on the wall the device was often forgotten. Multiple students were heard telling others to be careful with the device, expressing that he or she was concerned of accidently getting the device wet.

> Girl takes the iPad and looks for the crayfish in the bucket. Another girl in her group tells her "Don't get it wet" and grabs the device. This girl holds the device,

cradling it to her chest. (Program 3)

> Boy and Girl look over another boy's shoulder as he uses the iPad. The boy with the iPad decides to run back to look at the bucket with the iPad. As he does so he cradles the iPad close to his chest. (Program 6)

In three of the nine programs there were cases where adults took mobile devices away from students while students were supposed to be entering data. These adults seemed hesitant to allow students to handle mobile devices or untrusting of students' ability to enter data correctly.

> Educator holds the iPad while Group2 looks at the macro-invertebrates and tries to identify them. (Program 3)

> The teacher puts down the iPad on the bench. As soon as she does this Boy goes to pick up the iPad. He looks at the lab report on the iPad. The teacher quickly takes the iPad away from Boy. (Program7)

Comprehension

Comprehension proved to be difficult to assess from the data entered into the iPads, but observations of students in the process of learning while using mobile devices were abundant.

Using mobile devices as instruments for learning

Mobile devices were most commonly used by students as an identification tool to either verify that they had identified the correct name for their chosen macro-invertebrate or in some cases as a replacement for the dichotomous key aiding in initial identification. Upon identifying their macro-invertebrate a few students were observed using pictures in the Water Quality app as a reference to draw their chosen macro-invertebrate.

> Boy uses the paper dichotomous key. The teacher shows him the macro-invertebrate that he identifies on the iPad. They verify the macro-invertebrate by looking at the picture on the iPad. Girl looks on. (Program 7)

> Girl tells Boy that no she is using the iPad. Girl is using the device as a reference while she draws a picture. (Program 8)

Mobile devices were used both individually and collaboratively by students to learn about macro-invertebrates and enter data. When used individually, a student would look up something on a mobile device for a period of time and then pass the device to another group member. When used collaboratively, mobile devices were used in groups of two or three to learn about different macro-invertebrates. Often one group member would hold the device and record collected data as it was found by other group members. This method proved to be an effective and quick way for students to record their data. Groups that chose to collect data as such did so on their own and without guidance from an adult. In a few cases, one student would become less interested in the device and wander over to another group, pick up the Wacky Water Critter book (Wade & Emmling, 2001), or ignore the identification process completely.

> The two boys in the group take turns using the iPad, though after some time they decide to use the device together. One boy pushes something on the iPad. It is assumed again that they are entering data as they are also looking in the bucket and talking to each other. (Program 3)

> Girl takes the iPad. She opens to the lab report while she looks into the bucket. Two other girls in her group decide to work together to identify macro-invertebrates. They point out macro-invertebrates while they figure out what they are. Girl with the iPad enters macro-invertebrates into the app. (Program 9)

The Wacky Water Critter book, an alternative to a mobile device and app, was also used occasionally by students as an additional resource. The Wacky Water Critter book was only used in the first four programs and its use was closely connected to educator influence.

Students were noticeably excited to share what they found on mobile devices with others. Students were more inclined to share pictures of macro-invertebrates with teachers or fellow classmates then their collected data. Pictures were usually shared with comments in regards to how “gross” the macro-invertebrate looked. Pictures were shared with teachers and classmates equally.

> Girl is interested in the crayfish. She takes the iPad from the other girl in her group and finds a picture which she shows to the educator. (Program 8)

Mobile devices were allowed to remain with students during seven of the nine program wrap ups. During this time educators asked students' questions in regards to the type and number of macro-invertebrates that they had collected, and discussed the calculated biotic index. It was difficult to tell if students were using mobile devices for educational purposes. Those students with mobile devices were still observed answering educator's questions correctly, their attention quickly shifting between the device and the educator. Those students without direct access to mobile devices during this time either ignored the devices completely or looked at their neighbor's.

> The two girls play on the iPad, while the educator talks about rating the river; they completely ignore the educator. One of the girls raises her hand to answer the educator's question but then goes back to looking at the iPad. (Program 1)

Chapter 5: Discussion

The purpose of this study was to determine children's attitudes, behaviors, and comprehension while using mobile devices in outdoor environmental education programs. This chapter will address potential threats to trustworthiness, interpret and discuss the results, and offer recommendations for future research.

Interpretation of Results

Results from coded themes showed that the majority of students participating in programs were excited and interested to use mobile devices. Those students who did not demonstrate exaggerated signs of excitement or interest in the devices still appeared to remain focused on educators throughout the programs, revealing similar results to other studies (Chavez, 2009; Goundar, 2011; Harmon & Gleason, 2009; Kerlin & Herman, 2013; Looi et al., 2011; Workman & Hatzenbihler, 2014). Often students asked educators if they could take mobile devices home which led the researcher to believe that for many participants in the study, iPads were fairly new items. This newness factor did result in some negative interactions among students. Occasionally, students were observed having difficulties sharing mobile devices, though with help and guidance from educators, these difficulties could be easily overcome to create a more positive learning environment.

This study found that even though students were initially interested in mobile devices, their interest and excitement did not prove to be greater than their interest in nature. Macro-invertebrates proved to capture student attention more often and over long periods of time, even when mobile devices were available for use. It is believed by the researcher that this was because macro-invertebrates are more dynamic and provide a particular element of surprise that mobile devices do not. Other studies have proven children to be more engaged when in nature, as experiences in the natural world target sensory practices, thus creating richer understanding (James & Bixler, 2008). It was extremely interesting for the researcher to observe nature prevailing over digital technologies as digital technologies are often perceived as having a negative impact on children interactions with nature, though some research suggests the possibility of digital technologies enabling students to create deeper connections to the natural world, aiding in child development (Kerlin & Herman, 2013; Wolf, 2003; Workman & Hatzenbihler, 2014).

While using mobile devices, students had limited to no issues navigating the devices and were often observed showing adults how to correctly use the Water Quality app to record data and find information. These actions displayed the clear difference between, what Mark Prensky (2001a) describes as digital natives and digital immigrants. Looi et al. (2011) observed similar results, documenting that elementary students were able to easily navigate and use mobile devices for learning. The pilot study testing use of the Water Quality app in 2012 had similar findings as well, showing that upper elementary students participating in programs were able to use mobile devices and associated apps easily.

Students were careful and showed respect while using mobile devices, though it was important for educators to set clear behavioral expectations in order to keep students on task. Further analysis of data found that the majority of student groups (55/62) used devices for data collection purposes by entering data. It is mostly unknown as to why some groups chose not to enter data into their device though it is also important to note that some groups were unable to enter data into their devices due to adult interference and perceived reluctance to give students devices.

It was difficult to determine students' comprehension while using mobile devices in their programs, though students did frequently demonstrate learning processes, enabling the researcher to conclude that students did learn while using mobile devices. Similar studies have shown students to be more engaged in science material while using mobile technologies in their programs and noticed students making connections to challenging concepts (Kerlin & Herman, 2013; Looi et al., 2011).

The literature describes mobile learning environments as beneficial learning opportunities that enable students to learn after outdoor environmental education programs back in the indoor classroom (Cochrane et al., 2013; Jeng et al., 2010; Traxler, 2005; Thinley et al., 2014). In this study there was no follow up with teachers to determine how student collected data was used after each class's visit, though it was interesting to observe how students chose to use mobile devices during wrap up portions of program when they were allowed to keep devices. Students were often observed referring back to devices while answering questions suggesting that the devices were enabling them to continue learning from one activity to the next.

The literature also suggests that mobile devices are appropriate instruments for fostering learning in educational settings through a social constructivist approach. Social constructivism is based on the idea that children learn best through social activities and collaboration to build upon one's pre-existing knowledge (Ozer, 2004). Mobile learning or M-learning environments are flexible platforms that encourage students to interact with others to construct meaning from educational content (Thinley et al, 2014). M-learning environments allow students to be mobile, moving from physical location to physical location which appears to work well in outdoor environmental education programs or similar programs (Chen et al., 2003; Sugimoto et al., 2006). In this study, students were often observed taking advantage of the mobility of the devices by walking to other group members or over to other groups, sharing newly discovered information with each other. This appeared to extend the learning environment to other group members as well as other groups within programs.

Conclusions

Recommendations for Practice

Mobile devices are helpful data collection instruments, educational mobile learning platforms, and multimedia devices that can present information through a means that connects better with today's youth, and there are many possibilities to integrate them into outdoor programs. For practitioners planning to integrate mobile devices into environmental education programs it is recommended that the mobile devices be integrated seamlessly into a program as educational instruments, not as a main focal point of the program. When using mobile devices in programs keep use simple.

Additional time should be allowed prior to actual programs to ensure staff confidence in using mobile devices. When instructing students how to use mobile devices, be clear and concise with additional attention given to outlining behavioral expectations.

Recommendations for Future Research

Results from this study provide base line knowledge showing how children interact with nature and each other when given mobile devices in outdoor environmental education programs. This knowledge provides the foundation for further research in regards to mobile digital technology integration into outdoor environmental education programs.

There are many interesting questions for future research, though it is important to realize that digital technologies are quickly changing and the most beneficial research will be transferable across multiple forms or types of digital technology. It would be interesting to conduct a closer analysis of proper mobile digital technology integration techniques in outdoor environmental education programs to determine guidelines for best practice. It would also be interesting to compare use of digital technologies and non-digital technologies in outdoor environmental education programs to determine if one platform enables children to learn better. And finally, it would be interesting to look closer at whether or not mobile digital technologies enhance a child's connection to nature.

Literature Cited

American Camp Association. (2013). Enhancing the lives of children & families through quality camp experiences. Retrieved from http://www.acanewengland.org/

Ardoin, N. M., Clark, C., & Kelsey, E. (2012). An exploration of future trends in environmental education research. *Environmental Education Research*, 19(4), 499-520. doi: 10.1080/13504622.2012.709823

Association of Nature Center Administrators. (2013). About anca and who we support. Retrieved from http://www.natctr.org/index.php?id=86

Barnett, M., Houle Vaughn, M., Strauss, E., & Cotter, L. (2011). Urban environmental education: leveraging technology and ecology to engage students in studying the environment. *International Research in Geographical and Environmental Education*, 20(3), 199-214.

Birks, M., & Mills, J. (2011). *Grounded theory: A practical guide*. Los Angeles, Calif.:Sage.

Black, T. (1999). *Doing quantitative research in the social sciences*. London: SAGE Publications Ltd.

Bonk, C. J., & Cunningham, D. J. (1998). Electronic collaborators: Learner centered technologies for literacy, apprenticeship, and discourse. Mahwah: Erlbaum.

Brody, M. (2005). Learning in nature. *Environmental Education Research*, 11(5), 603-621.

Chavez, D. J. (2009). Youth day in Los Angeles: Connecting youth and nature with technology. HICSS Proceedings, 284-293.

Chen, Y., Kao, T., Sheu, J., & Chiang, C. (2002). A mobile scaffolding-aid based bird-watching learning system. *Wireless and Mobile Technologies in Education*, 15-22. doi: 10.1109/WMTE.2002.1039216

Cochrane, T., Narayan, V., & Oldfield, J. (2013). IPadagogy: Appropriating the iPad within pedagogical contexts. *International Journal of Mobile Learning and Organisation, 7*(1), 48-65.

Cox, J., & Cox, K. (2009). Constructivism and integrating technology in the classroom. Retrieved from http://edtech2.boisestate.edu/coxk/eportfolio/EdTech 504 Final Synthesis K&J.docx.pdf

Glaser, BG. & Strauss, AL. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine De Gruyter.

Goundar, S. (2011). What is the potential impact of using mobile devices in Education? Retrieved from http://www.globdev.org/files/Shanghai Proceedings/14 REVISED Goundar Using Mobile Devices in Education – Final.pdf

Gupta, A. (2008). Environmental education with special reference to technology: Past, present, and the future. Retrieved from http://www.academia.edu/1001807/Environmental_Education_with_Specal_Reference_to_Technology_Past_Present_and_Possibilities_for_Future

Harmon, Laurlyn K. and Mark Gleason (2009). "Underwater Explorers: Using Remotely Operated Vehicles (ROVs) to Engage Youth with Underwater Environments." *Children, Youth and Environments* 19(1): 125-143.

Holloway, P., & Mahan, C. (2012). Enhance nature exploration with technology. *Science Scope*, 35(9), 23-28.

Hung, P., Lin, Y., & Hwang, G. (2010). Formative assessment design for pda integrated ecology observation. *Educational Technology & Society*,13(3), 33-42.

James, J. J., & Bixler, R. D. (2008). Children's role in meaning making through their participation in an environmental education program. *Journal of Environmental Education*, 39(4), 44-59. doi: 10.3200/JOEE.39.4.44-59

Jeng, Y.-L., Wu, T.-T., Huang, Y.-M., Tan, Q., & Yang, S. J. H. (2010). The Add-on Impact of Mobile Applications in Learning Strategies: A Review Study. *Educational Technology & Society, 13* (3), 3–11.

Kellert, S. (2005). *Building for life: Designing and understanding the human nature connection.* Washington, DC: Island Press.

Kerlin, S., Herman, L., Mell, R. Wisconsin Association for Environmental Education Annual Conference, "Water Quality: A Stream Study Mobile App to Enhance Learning," UW-Lacrosse, WI. (August 7-9, 2013).

Kerlin, S., Steinitz-Kannan, M., & Mayfield, H. in collaboration with the NKU Center for Applied Informatics. (2012). Water Quality [Apple mobile application software]. Highland Heights: KY.

Kim, M. C., Hannafin, M. J., & Bryan, L. A. (2007). Technology-enhanced inquiry tools in science education: An emerging pedagogical framework for classroom practice. *Wiley InterScience*, 1010-1030. doi: 10.1002/sce.20219

Lincoln, YS. & Guba, EG. (1985). *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications

Looi, C. K., Zhang, B., Chen, W., Seow, P., Chia, G., Norrist, C., & Soloway, E. (2010). 1:1 mobile inquiry learning experience for primary science students: A study of learning effectiveness. *Journal of Computer Assisted Learning*, (27), 269-287. doi: 10.1111/j.1365-2729.2010.00390.x

Merriam, S. (2009). *Qualitative research: A guide to design and implementation.* San Francisco, CA: A Wiley Imprint.

Merriam-Webster. (2013a). Academic. Retrieved from http://www.merriam webster.com/dictionary/academic

Merriam-Webster. (2013b). Performance. Retrieved from http://www.merriam webster.com/dictionary/performance

Merriam-Webster. (2013c). Behavior. Retrieved from http://www.merriam webster.com/dictionary/behavior

Merriam-Webster. (2013d). Characteristic. Retrieved from http://www.merriam webster.com/dictionary/characteristic

Merriam-Webster. (2013e). Comprehension. Retrieved from http://www.merriam webster.com/dictionary/comprehension

Merriam-Webster. (2013f). Technology. Retrieved from http://www.merriam webster.com/dictionary/technology

NAAEE -What is environmental education. (2011). Retrieved from http://www.naaee.net/what-is-ee

Nature Learning Initiative. (2012). Benefits of connecting children with nature: Why naturalize outdoor learning environments. Retrieved from http://naturalearning.org/sites/default/files/Benefits of Connecting Children with Nature_InfoSheet.pdf

O'Leary, Z. (2010). *The essential guide to doing your research project*. London: SAGE Publications Ltd.

Oliver, R., & Herrington, J. (2003). Exploring technology-mediated learning from a pedagogical perspective. *Interactive Learning Environments*, 11(2), 111

126.

Ozer, O. (2004). Constructivism in piaget and vygotsky. *The Fountain Magazine*, (48), Retrieved from http://www.fountainmagazine.com/Issue/detail/CONSTRUCTIVISM-in-Piaget-and-Vygotsky

Patton, M. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). Sage Publications.

PC Magazine. (2013). Definition of ipad. Retrieved from http://www.pcmag.com/encyclopedia/term/61359/ipad

Peffer, T. E., & Bodzin, A. M. (2013). The use of technology by nonformal environmental educators. *Journal of Environmental Education*, 44(1), 16-37. doi: 10.1080/00958964.2012.688775

Pegrum, M., Howitt, C., & Striepe, M. (2013). Learning to take the tablet: How preservice teachers use iPads to facilitate their learning. *Australasian Journal of Educational Technology, 29*(3), 464-479.

Prensky, M. (2001a). Digital natives, digital immigrants. *On the Horizon*, *9*(5), 16.

Prensky, M. (2001b). Digital natives, digital immigrants, part ii: Do they really think differently? *On the Horizon*, 9(6).

Riddick, C., & Russell, R. (2008). *Research in recreation, parks, sport, and tourism*. (Ex: 2nd ed.). Urbana, IL: Sagamore Publishing LLC.

Strauss, A. & Corbin, J. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, CA: Sage Publications.

Sugimoto, M., Ravasio, P., & Enjoji, H. (2006). Sketchmap: A system for supporting outdoor collaborative learning by enhancing and sharing learners' experiences. Retrieved from http://www.academia.edu/1085326/Sketchmap_a_system_for_supporting outdoor_collaborative_learning_by_enhancing_and_sharing_learners_ experiences

Techopedia. (2014). Mobile device. Retrieved from http://www.techopedia.com/definition/23586/mobile-device

Thinley, P., Geva, S., & Reye, J. (2014). Tablets (iPad) for M-Learning in the

Context of Social Constructivism to Institute an Effective Learning Environment. *International Journal of Interactive Mobile Technologies 8*(2), 16.

Torquati, J., Gabriel, M. M., Jones-Branch, J., & Leeper-Miller, J. (2010). A natural way to nurture children's development and learning. *Young Children*, 65(6), 98-104.

Traxler, J. (2005, January 1). Interactions Journal. Retrieved February 24, 2015, fromhttp://www2.warwick.ac.uk/services/ldc/resource/interactions/issues/issu25/traxler

Wade, S., & Emmling, P. (2001). *Wonderful wacky water critters*. Madison, Wis.: University of Wisconsin-Extension

Welcome to Public School Review. (2015, January 1). Retrieved February 1, 2015, from http://www.publicschoolreview.com/

Wolf, C. J. (2003). Technology in environmental education. *Wilderness, Plain and Simple*, 2-6.

Workman, A., & Hatzenbihler, D. (2013, January 1). Technology Research in EE at Upham Woods Outdoor Learning Center. *Environmental Education in Wisconsin*.

Appendix A

Definition of Terms

Definition of Terms

- Academic Performance: execution of actions in relationship to schools and education
    - Academic: Of or relating to schools and education (Merriam-Webster, 2013a).
    - Performance: execution of an action (Merriam-Webster, 2013b).
- Attitude: Refers to the participant's feelings, opinion, or views (Riddick & Russell, 2008).
- Behavior: the response of an individual, group, or species to its environment (Merriam-Webster, 2013c).
- Characteristic: distinguishing trait, quality, or property (Merriam-Webster, 2013d).
- Camp: as a sustained experience, which provides a creative, recreational, and educational group living opportunity in the out-of-doors (American Camp Association, 2013).
- Comprehension: the act or action of grasping with the intellect (Merriam-Webster, 2013e).
- Constructivism: A learning theory based on the idea it is the role of the teacher to foster new learning based on a student's wealth of knowledge, skills, and past experiences. Constructivism involves language, real world situations, and interaction and collaboration among learners (Ozer, 2004).
- Digital Age: A time where society is technology driven (Gupta, 2008).
- Digital Immigrant: A person that was born before the use of electronic

technologies became common, but is fascinated by and willing to adapt these electronic technologies in many ways. (Prenksy, 2001a)

- Digital Native: A person who has been born in a time where they have had contact to electronic technologies their entire lives and are "… 'native speakers' of the digital language of computers, videogames, and the Internet". (Prensky, 2001a)
- Environmental Education: A type of education that teaches exploration and investigation of the environment, so that children and adults can make intelligent, informed decisions involving the environment (NAAEE, 2011).
- Environmental Educator: An individual who teaches children and adults ways that they can explore and investigate the environment (NAAEE, 2011).
- iPad: A device developed by Apple that is designed for web browsing, e-book reading, use of applications, and entertainment (PC Magazine, 2013).
- Mobile Device: A mobile device is basically a handheld computer that has been designed to use applications (Techopedia, 2014).
- Nature Center: A facility that brings environments and people together under the guidance of trained professionals to experience and develop relationships with nature. A nature center serves its community and fosters sustainable connections between people and their environment (Association of Nature Center Administrators, 2013).
- Social Constructivism: A constructivist based learning theory that believes that learning and development is a collaborative activity and that children are cognitively developed in the context of socialization and education (Ozer, 2004).

Technology (educational): the practical application of knowledge especially in a particular area (Merriam-Webster, 2013f).

Appendix B

Consent Form:

Riveredge Nature Center Educators

Consent Form: Riveredge Nature Center Educators

Visitors of all ages participate in programs at the Riveredge Nature Center and many more visitors recreate on their property on a daily basis. No part of the observed programs will be changed or altered as a result of this study, and there will be no interactions between program participants and observer. All data collected will be anonymous. Therefore, only the Riveredge Nature Center educators teaching the program will be asked to sign the informed consent form below.

Informed Consent to Participate in Human Subject Research

You are being asked to participate in a research study conducted by Joy Kacoroski, a graduate student in the College of Natural Resources at the University of Wisconsin-Stevens Point. The purpose of this study is to understand the impact of the use of mobile devices, specifically iPads, on a child's connection to nature during an outdoor environmental education program. Your participation is appreciated, as it will aid in understanding the role of technology in outdoor environmental education programs. This study will contribute to the student's completion of her master's thesis. Should you choose to participate in this study, you will be asked to sign this consent form once all of your questions have been answered to your satisfaction.

As a part of this study, your class will be observed while they use iPads during their River Connection program at the Riveredge Nature Center. Participation in this study will last the duration of your program at the Riveredge Nature Center. The researcher perceives minimal risks from your involvement in this study.

While there might not be an immediate benefit from this study to you, this study may include the opportunity to reflect on your own education programs and to contribute to knowledge on a topic that has not been extensively researched.

The results of this research will be included in the researcher's master's thesis and may be published in a scholarly journal or magazine article, as well as presented at state and national conferences. The data for this study will be collect in a way that the participating teachers and student's identities will not be collected thus will not be included in the final form of this study. The researcher retains the right to use and publish non-identifiable data. All data will be stored in a secure location accessible only to the researcher.

Your participation is entirely voluntary. If you choose to participate, you can withdraw at any time without any consequences.

Once the study is completed, you may receive the results of the study. If you would like these results, or if you have any questions in the meantime, please contact:

Joy Kacoroski, Wisconsin Center of Environmental Education, University of Wisconsin-Stevens Point, 800 Reserve Street TNR 110, Stevens Point, WI 54481, (425)761-7134

If you have any complaints about your treatment as a participant in this study or believe that you have been harmed in some way by your participation, please call or write:

Dr. Jason R. Davis, Chair, Institutional Review Board for the Protection of Human Subjects School of Business and Economics, University of Wisconsin-Stevens Point, Stevens Point, WI 54481, (715) 346-4598

Although Dr. Davis will ask your name, all complaints are kept in confidence.

I have received a complete explanation of the study and I agree to participate.

Name____

Date_____________________ (Signature of subject)

This research project has been approved by the UWSP Institutional Review Board for the Protection of Human Subjects.

Appendix C

Definition of Codes

Codes used to develop categories and observational themes.

Code	Definition	Number of Programs code occurred	Number of times code occurred
Adult Intervention of iPad	Teacher or educator moves to take away the iPad from the student to focus their attention to particular learning	4	11
Collaborative Use	Working together, sharing with each other	6	23
Con iPad	Students have a negative attitude towards iPad	9	78
Confusion	Confusion or difficulty using iPad	4	6
Demonstrated Learning	Sharing information with each other, comments out loud, using iPad for learning, using iPad as a proper tool, using iPad for a purposeful use	9	45
Digital Native	Can use the device without a problem	9	26
Disrespect	Students are disrespectfully using iPads	0	0
Distraction Caused	Unfocused, not doing the activity, not using iPad as a tool	6	27
Educators	Educators interacting with students and the program	9	28
Effective Instruction	The educator's instruction as to how to use iPads was effective and the students understood how/when to use the iPads	5	11
Handling iPads	Students are respectful using iPads	8	33
Indifference	Nature trump or demonstrated indifference	7	40
Ineffective Instruction	The educator's instruction as to how to use iPads was ineffective and the students were confused or the devices were not used correctly	4	6
Initial Device Reaction	Students initial reaction to iPads	9	22
iPad Attitudes	Student attitudes in regards to iPads	9	226
iPad Behaviors	Student expressed behaviors	9	229
iPad Curiosity	Students express a curiosity in their attitude towards iPads	2	6
iPad Disinterest	Students show no interest in iPad though it is available as a resource	6	12
iPad Instruction	Instruction on how to use iPads given by the educators	9	17
iPad Interest	Student uses iPad to show something to a classmate or educator/teacher	6	19

iPad Learning Interest Specific	Student use iPad for learning	3	11
Nature Trump	Times when nature trumped while iPads were available for use	9	58
Negative Engagement	Students expressed negative engagement behaviors	7	93
Neutral iPad	Students are neutral towards iPads, no strong positive or negative attitudes	4	9
Newness	Curiosity, excitement, initial reaction	7	28
Not Appropriate Learning	Students do not use iPad for Learning	2	4
Positive Engagement	Student expressed positive engagement behaviors	9	108
Pro iPad	Students have a positive attitude towards iPads	9	11
Problems Sharing	Students do not want to share iPads	4	16
Respectful Use of iPads	How the students handle iPads	9	28
Sharing Info	Students share something on iPad with another	6	13
Trump iPad Time	Nature trumped when students are specifically supposed to be using iPads	7	24

Appendix D

iPad Evaluation Rubric

Used to assess students use of iPads during programs.

River Connections	Program:	Date:	School:

iPads

iPad #	Open Screen	Opened Other Apps	Photos Taken	Other
1	2nd Home Screen	No	0	-
2				
3				
4				
5				
6				

Lab Report

Group	Photo	Weather Data	Measurement Data	Macro-invertebrate Data	Four Taxa / Three Taxa	Total	Types of Macro-invertebrate	#
2(1)	No	48.47c	No	Yes	4/3 (poor)	12		
							Stonefly Nymph	
							Mayfly Nymph	
							Caddisfly Larva	
							Dobsonfly Larva	
							Riffle Beetle	
							Water Penny	
							Right-handed Snail	
							Damselfly Nymph	
							Dragonfly Nymph	
							Sowbug	
							Scud	
							Crane Fly Larva	
							Clam/Mussel	
							Crayfish	
							Midge	
							Black Fly Larva	
							Planaria	

							Leech	
							Left-handed Snail	
							Aquatic Worm	
							Blood Midge	
							Rat-tailed Maggot	
3(2)								
							Stonefly Nymph	
							Mayfly Nymph	
							Caddisfly Larva	
							Dobsonfly Larva	
							Riffle Beetle	
							Water Penny	
							Right-handed Snail	
							Damselfly Nymph	
							Dragonfly Nymph	
							Sowbug	
							Scud	
							Crane Fly Larva	
							Clam/Mussel	
							Crayfish	
							Midge	
							Black Fly Larva	
							Planaria	
							Leech	
							Left-handed Snail	
							Aquatic Worm	
							Blood Midge	
							Rat-tailed Maggot	
4(3)								
							Stonefly Nymph	
							Mayfly Nymph	
							Caddisfly Larva	
							Dobsonfly Larva	
							Riffle Beetle	
							Water Penny	
							Right-handed Snail	
							Damselfly Nymph	
							Dragonfly Nymph	
							Sowbug	
							Scud	
							Crane Fly Larva	
							Clam/Mussel	
							Crayfish	

							Midge	
							Black Fly Larva	
							Planaria	
							Leech	
							Left-handed Snail	
							Aquatic Worm	
							Blood Midge	
							Rat-tailed Maggot	
7(4)								
							Stonefly Nymph	
							Mayfly Nymph	
							Caddisfly Larva	
							Dobsonfly Larva	
							Riffle Beetle	
							Water Penny	
							Right-handed Snail	
							Damselfly Nymph	
							Dragonfly Nymph	
							Sowbug	
							Scud	
							Crane Fly Larva	
							Clam/Mussel	
							Crayfish	
							Midge	
							Black Fly Larva	
							Planaria	
							Leech	
							Left-handed Snail	
							Aquatic Worm	
							Blood Midge	
							Rat-tailed Maggot	
8(5)								
							Stonefly Nymph	
							Mayfly Nymph	
							Caddisfly Larva	
							Dobsonfly Larva	
							Riffle Beetle	
							Water Penny	
							Right-handed Snail	
							Damselfly Nymph	
							Dragonfly Nymph	
							Sowbug	
							Scud	

							Crane Fly Larva	
							Clam/Mussel	
							Crayfish	
							Midge	
							Black Fly Larva	
							Planaria	
							Leech	
							Left-handed Snail	
							Aquatic Worm	
							Blood Midge	
							Rat-tailed Maggot	
9(6)								
							Stonefly Nymph	
							Mayfly Nymph	
							Caddisfly Larva	
							Dobsonfly Larva	
							Riffle Beetle	
							Water Penny	
							Right-handed Snail	
							Damselfly Nymph	
							Dragonfly Nymph	
							Sowbug	
							Scud	
							Crane Fly Larva	
							Clam/Mussel	
							Crayfish	
							Midge	
							Black Fly Larva	
							Planaria	
							Leech	
							Left-handed Snail	
							Aquatic Worm	
							Blood Midge	
							Rat-tailed Maggot	

Activity Time:
iPad Time:
Other Comments: