Bridging the Divide: The Integration of Nature-Based Learning and Technology Together in Education

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Abstract

This qualitative research study examined the challenges, benefits, and outcomes associated with the integration of nature-based learning and technology together in education, guided by the research question: How is a small sample of primary/junior elementary educators in Canada integrating nature-based learning and technology together to support students’ learning and development, and what outcomes do they observe from students? Convenience sampling was used to contact an elementary teacher and an outdoor education technician who integrate nature-based learning and technology together in their practice in the Greater Toronto Area. Data was collected through semi-structured interviews with these educators, and the transcripts were reviewed to reveal three main themes. The findings suggest that nature-technology integration has benefits for students in relation to academics, socio-emotional development, and engagement. The findings also propose that program goals, staff initiative, and access to resources are necessary supports for nature-technology integration. Finally, it was revealed that educators encounter challenges related to resources and staff initiative. The implications of these findings suggest that pre-service and in-service teachers require more knowledge and preparation to integrate nature and technology together, and that there needs to be increased support for this integration amongst all stakeholders including ministries of education, administrators, and teachers.

Key Words: nature-based learning, technology, integration
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Chapter 1: Introduction

1.0 Introduction: Research Context and Problem

As educators, the challenge of educating students in the twenty-first century can be a daunting process at times, especially when considering the often overwhelming presence and development of new technologies that are prevalent in many aspects of daily life, including devices like mobile phones, tablets, computers and SMART Boards. As a result of this occurrence, students today are spending much of their time with electronic devices and less time connecting with the natural environment (Bennett & Parise, 2014; Louv, 2005). In his book *Last Child in the Woods*, author Richard Louv (2005) explains that, “In the space of a century, the American experience of nature has gone from direct utilitarianism to romantic attachment to electronic detachment” (p.16). In turn, this is contributing to a problem known as nature-deficit disorder, a phrase contrived by Louv (2005) to describe “the increasing divide between the young and the natural world, and the environmental, social, psychological, and spiritual implications of that change” (p.2). As Louv (2005) describes, nature-deficit disorder is not a medical condition; however there are negative health and developmental consequences that can result from the disorder. In a world that is becoming increasingly dependent on technology for many facets of everyday life, it is thus important to consider the opportunities for learning and growth that students may miss out on if this disconnection from nature continues to afflict our society.

Although issues like nature-deficit disorder have the potential to arise as a result of the overuse of technology, it is not to say that technology should be viewed harshly. After all, technology has many benefits to offer to the field of education. For instance, many technologies have been found to increase motivation and engagement in students, and some technologies can
be used to differentiate instruction for a variety of learners (Beggs, Shields, Telfer & Bernard, 2013; Wood, Specht, Willoughby & Mueller, 2008) and across multiple subject areas including math, language, science, and social studies (Ontario Ministry of Education, 2007; Wang, Kinzie, McGuire, & Pan, 2009). Furthermore, research has suggested that technology may also be useful for children with autism spectrum disorders. For example, computer-assisted technologies, such as video modeling, visual feedback, games, and computer programs, have been found to assist children with autism spectrum disorders in improving their social and communication skills (Ploog, Scharf, Nelson & Brooks, 2012). For these reasons, various technologies may prove to make a useful addition to classrooms to be used in conjunction with traditional teacher-lead experiences in order to improve students’ overall learning and success.

Conversely, it is becoming increasingly clear that it is necessary for nature and environmental education to be given more prominence within schools in an attempt to leverage out the current imbalance that is occurring between the use of nature and technology. Just as technology has the ability to engage students and improve their academic success, so too does nature (Ontario Ministry of Education, 2009; Tan & Pedretti, 2010). Research also points to several health benefits associated with contact with nature, some of which include stress relief (Louv, 2005; Chawla, Keena, Pevec & Stanley, 2014) and improved concentration skills (Louv, 2005). As Driessnack (2009) noted, children are “in danger of losing their capacity to think or learn about the world directly” (p.73), and so, an increased focus on environmental education and natural outdoor experiences is one of the ways that educators can encourage children to once again rekindle a connection with their local communities and to learn about problems in a real-world context (OMOE, 2007). Moreover, some studies suggest that exposure to nature may be particularly beneficial for children with attention deficit disorders. For example, the use of green
outdoor settings has been linked to decreases in the symptoms associated with attention deficit disorders in children (Faber Taylor, Kuo & Sullivan, 2009; Van Den Berg & Van Den Berg, 2010). With this information in mind, it is clear that a greater focus on environmental education and natural outdoor experiences in the education system has the potential to lead to a more inclusive approach to education that better supports the health and development of all students.

Although there is much to be said about the benefits of both technological and natural outdoor experiences for students, in reality there are many obstacles that stand in the way of implementing either in the education system. For example, the 2007 report *Shaping Our Schools, Shaping Our Future* (Ontario Working Group on Environmental Education) explained that there were gaps found in implementing environmental education consistently across the province of Ontario, which may have stemmed from issues such as a lack of teacher training in the area of environmental education and the shortage of topics focused directly on environmental education present in the Ontario curriculum prior to the introduction of the report. Current research suggests that other factors, including an overcrowded curriculum (Spence, Wright & Castleden, 2013; Tan & Pedretti, 2010) and teachers’ perceptions (Ernst, 2014), continue to act as limitations in the implementation of nature and environmental education in schools today. In regards to technology integration, too, several studies have indicated that teachers feel unprepared to properly integrate technology into their classrooms (Beggs et al., 2013; Leonard & Leonard, 2006; Wood et al., 2008), and issues like funding and “managing children’s access to the computers” (Wood et al., 2008, p.223) can further prove challenging.

To continue, despite research that notes the many benefits of utilizing nature and technology to improve children’s learning and engagement, there remains an imbalance between the access to and use of nature and technology in education, and many educators have indicated
that they face several barriers in implementing such programming in schools. An interesting
direction to consider now is whether technology and natural experiences can be combined in an
educational context. Rather than viewing technology and nature as separate components, it may
be valuable to consider the implications of using technology to enhance nature and
environmental education. For instance, Boyce, Mishra, Halverson and Thomas’ (2014) study
found that incorporating field-friendly technology, specifically the iPad, on an outdoor hike
assisted in creating student interest in science. This suggests the possibility of utilizing nature
and technology in conjunction with one another to heighten student learning and engagement
(Boyce et al., 2014). Similarly, in a recent magazine article, Carie Green (2016) also suggested
that educators could make use of cameras within the context of environmental education. As she
explained, students could be instructed to wear such devices which would be used to record their
observations, comments and actions within a natural environment, thereby creating a sensory
tour depicting each student’s interactions with nature. It was described that these video tours may
help to bring nature-based learning back into the classroom and that they have the potential to
then elicit further inquiry into other units of study based on the students’ observations (Green,
2016). Such endeavors in the education system may therefore be instrumental in encouraging
students to connect with nature, redistributing the balance between nature and technology and
also working to decrease instances of nature-deficit disorder (Louv, 2005).

1.1 Purpose of the Study

In light of the problem articulated, the goal of my research is to learn how educators in
primary/junior settings incorporate both nature-based learning and technology together to
promote engagement and learning for all students, and to gain insight into the outcomes that they
observe from their students. I also aim to learn about the challenges and barriers that educators
face in integrating aspects of nature-based learning and technology in education, as well as educators’ attitudes and beliefs surrounding utilizing both nature and technology to enhance students’ learning experiences. The overall goal of this research is to further inform educators in primary/junior settings about the benefits and strategies necessary for creating a balance between the use of nature and technology in education to assist in teaching curriculum content and helping all children to achieve better learning outcomes.

1.2 Research Questions

In light of the current context and problems addressed above, the main question that is the central focus of this research study is: How is a small sample of primary/junior elementary educators in Canada integrating nature-based learning and technology together to support students’ learning and development, and what outcomes do they observe from students?

In response to the main research question, the subsidiary research questions that further guided this study include:

- What challenges and barriers do educators face when integrating nature-based learning and technology in their classrooms and how do they respond to these obstacles?
- How do educators make use of their educational spaces and available resources to effectively implement learning experiences that incorporate aspects of nature-based learning and technology in their teaching? What factors and resources support them?
- How, if at all, do educators utilize technology to enhance students’ engagement with nature-based learning, and vice versa?
- What outcomes, if any, do educators observe in students in terms of interest, engagement and understanding of course material in relation to or as a result of integrating nature-based learning and technology?
1.3 Reflexive Positioning Statement

Growing up, I have always had a great appreciation for nature. During my own schooling from kindergarten to Grade 12, I had a few positive experiences with nature-based learning and outdoor education; although, such opportunities were limited and often part of specialized programming like field trips. As an example, I travelled to an outdoor education centre as part of a class trip in elementary school. While there, we went on hikes, camped outside, observed local ecosystems and learned basic skills for determining what the weather would be for the day. That trip was one of the most valuable and engaging experiences that I remember from my early schooling. As a second example, my Grade 6 teacher was fond of the arts and nature. On a couple of occasions, I recall her taking our class outside to write poetry inspired by the sights and sounds of nature in our school yard. I believe that such experiences helped me to develop an appreciation for the aesthetic beauty and calming capabilities of nature, something that I wish to encourage in my own future students.

When I attended college, one of my course professors demonstrated how instilling a love of nature in students and providing them with opportunities to experience the outdoors can prove beneficial for both their learning and development. My professor ensured that my classmates and I were given those same opportunities to engage and connect with nature ourselves. For instance, she led us on a walk through our school’s arboretum to observe the plant and wild life within it, and she invited us to sketch an object or animal that we found interesting. For me, the experience solidified that the natural environment holds many opportunities for learning. Although the activities were simple, they opened my eyes up to the diverse features of the environment that were present in my own school’s local community, and for me at least, they helped to further forge my connection with and appreciation for the beauty of nature. My professor later
challenged our class to develop our own lesson plans with an environmental education focus, a task which I had not previously thought to create in my own practice. In these ways, my professor’s passion for integrating nature into educational experiences inspired me to reflect on how to best include those teachings in my own future practice.

My appreciation for the value of nature, in combination with my lack of confidence in utilizing technology to enhance classroom learning, has encouraged me to develop a strong interest in discovering how to integrate both nature and technology together in schools to better support student learning and engagement in my own future practice as a primary/junior educator. I understand that there are many positive outcomes associated with using both nature and technology to create hands-on learning experiences for children; however, I would like to gain more insight into the strategies that will help to make such learning experiences more meaningful for students by creating a balance between the use of nature and technology together in education. Statistics show that there is a stark divide between the highest and lowest income earning families in terms of access to the internet, suggesting that there are issues of inequality in regards to students who are able to access technology (Chen, Gallagher-Mackay & Kidder, 2014). Secondly, some educators have expressed that a lack of access to nature is one of the main barriers to the inclusion of natural outdoor experiences in their practice (Ernst, 2014). For instance, Barton (2001) discussed that socioeconomic and geographic circumstances may pose challenges for some students in relation to whether or not they have access to natural spaces or informal learning environments like zoos, outdoor education centres and museums (Boyce et al., 2014). With these ideas in mind, my research will seek to uncover the additional barriers that educators perceive as challenges to the inclusion of nature and technology in schools as well as
the resources that are in place to support the integration of nature and technology in their practices in order to highlight the potential for alleviating some of those challenges.

1.4 Preview of the Whole

To respond to the research questions I conducted a qualitative research study using purposeful sampling to interview two teachers about their instructional strategies for integrating nature and technology and about the outcomes they observed from students. In Chapter 2 I review the literature in the areas of benefits of and strategies for incorporating nature and technology in primary/junior school settings. Next, in Chapter 3 I elaborate on the research design. In Chapter 4 I report my research findings and discuss their significance in light of the existing research literature, and in Chapter 5 I identify the implications of the research findings for my own teacher identity and practice, and for the educational research community more broadly. I also articulate a series of questions raised by the research findings, and point to areas for future research.
Chapter 2: Literature Review

2.0 Introduction

In this chapter, I review the literature in the areas relevant to the inclusion of both technological and natural experiences in schools, as well as the implications for integrating technology and nature together. More specifically, I review the policies currently in place in Ontario that support the inclusion of technology in schools, the academic benefits associated with students’ use of technology, including students with Autism, followed by the factors that impede the use of technology in schools. Next, I review the concept of nature-deficit disorder to highlight a prominent challenge stemming from the over-use of technology in the twenty-first century. From there, I discuss Ontario policies that promote the integration of nature and environmental education in schools, followed by a review of the research on the academic and health benefits of natural experiences for all students, including those with attention-deficit-hyperactivity-disorder, and the barriers to utilizing nature in schools. Finally, I review existing research about available technologies that enhance nature and environmental education and I discuss possible future directions for using various forms of technology to enhance natural learning experiences.

2.1 Technology

The Ontario curriculum science and technology (OMOE, 2007) document states that, “During the twentieth century, science and technology played an increasingly important role in the lives of all Canadians” (p.3). As we now move forward through the twenty-first century, “The impact of science and technology on our lives will continue to grow” (OMOE, 2007, p.3) and “students are going to live and work in a world where people use their devices 24/7” (Peel District School Board, 2016, para.5). This presents a new outlook on education that schools must
take into consideration, as technology now “seems to impact all aspects of teaching and learning” (Beggs et al., 2013, p.23). With this in mind, it is essential that educators find innovative ways to incorporate technology into students’ learning experiences in order to engage students and to best prepare them for success within the increasingly global community that they will grow up in. The proceeding section of this paper will address some of the policies within Ontario that are working to support technology integration within schools, as well as discuss both the benefits and challenges in incorporating new technologies into the education system. For the purposes of this paper, the technologies referred to throughout this paper will consist predominately of information and communication technologies, mobile devices including iPads and tablets, as well as SMART Boards and computers.

2.1 Policies that support the integration of technology in schools

In this section, I speak to three Ontario policies that support the integration of technology in schools. First, I discuss the role of the Ontario curriculum science and technology (OMOE, 2007), followed by the Ontario Software Acquisition Program (OSAPAC, 2014/2015a), and finally, Bring Your Own Device policies that have been enacted in many school boards across Ontario.

2.1.1 The Ontario curriculum science and technology

The Ontario curriculum science and technology (OMOE, 2007) document plays an important role in supporting the integration of technology in schools. The document states that technology is considered to be a “way of knowing, and is also a process of exploration and experimentation” (OMOE, 2007, p.4), emphasizing that technology plays an essential role in education in the twenty-first century. The Ontario curriculum (OMOE, 2007) also reiterates that cross-curricular learning, which is described as providing students “with opportunities to learn
and use related content and/or skills in two or more subjects” (p.30), is an expectation for educators to address in their practice. Technology is therefore an effective tool to use in “providing opportunities for cross-curricular learning in manageable and efficient ways” (Beggs et al., 2013, p.23), as educators can use various forms of technology to connect learning across several subjects including math, language, social studies and environmental education (OMOE, 2007).

2.1.1.2 Ontario Software Acquisition Program Committee (OSAPAC)

A program that is especially valuable and highlights the Ontario Ministry of Education’s commitment to supporting the use of technology in schools is the Ontario Software Acquisition Program (OSAPAC, 2014/2015a). The OSAPAC (Ontario Software Acquisition Program Advisory Committee) consists of a set of representatives from Ontario who advise the Ministry of Education “on the licensing and evaluation of Digital Resources for School Boards, Faculties of Education and First Nations Schools” (OSAPAC, 2014/2015a, para.3). The OSAPAC site lists several Ministry of Education licensed digital learning resources, providing a description of each individual software program and its potential for use in a school setting (OSAPAC, 2014/2015b). The website also provides educators with resources to assist them in learning how to incorporate Ministry-licensed technology into their practices. For example, one section of the site provides sample lessons submitted by educators across Ontario that highlight how to use various licensed technologies in different subjects of the curriculum (OSAPAC, 2014/2015c).

2.1.1.3 Bring your own device

Many Ontario school boards have started to introduce Bring Your Own Device (BYOD) policies into schools. Simply put, “BYOD means students bring their own devices to school for educational purposes” (Peel District School Board, n.d., p.1). In conjunction with guided
instruction from educators, BYOD initiatives can be beneficial in promoting student learning and success (Peel District School Board, n.d.). A document entitled “BYOD Bring Your Own Device: How parents can partner for student success” (Peel District School Board, n.d.) argues that BYOD policies that allow for students to bring their personal technological devices to school can be beneficial for student success in many ways. For instance, the document states that students can personalize their own devices to suit their individual learning needs, the devices can be used anytime both in and out of school which also allows for students to collaborate with one another, students’ personal devices are often more up-to-date than devices that schools have to offer, and school devices can be costly and difficult to sustain (Peel District School Board, n.d.). For these reasons, it may be valuable for more school boards across Ontario to consider implementing BYOD policies; however, there are some challenges associated with implementing BYOD in schools that will be discussed later.

2.1.2 Academic benefits related to technology use

The study of the potential benefits of technology integration in education has pointed to a number of interesting implications for both students and educators alike. As is described in the Ontario curriculum (OMOE, 2007), educators are expected to engage students in cross-curricular learning across multiple subject areas. Above, it was discussed that technology can be a useful tool that can help educators to lessen the gap in their ability to connect subjects across the curriculum (Beggs et al., 2013). Similarly, this is reiterated by Wang, Kinzie, McGuire, & Pan (2009) who state that “a growing number of interactive games and educational software packages have been implemented in early childhood education and addressed a variety of subjects, including mathematics, science, reading, language, and social studies (p.381). Authors Hoffman and Ritchie further note that of few of the numerous benefits for students include that
“multimedia technology can be used to increase representational richness of problems, offer timely information, individualize problem situations, monitor learning processes, and improve the efficiency of both creating problem scenarios and solving the problems” (as cited in Wang et al., 2009, p.382). Many mobile applications can also provide students with instant feedback, allowing for students to self-assess their progress in various content areas (Ciampa, 2014).

Technology can further assist educators in delivering effective differentiated instruction to meet the needs of many types of learners (Ciampa, 2014). For example, Ciampa (2014) argues that educators may not only have “the ability to adjust content to student level and allow self-paced learning” (p.83-84), but “the multimedia and interactive capabilities afforded by such mobile devices as the tablet allowed teachers to create multidimensional learning environments which catered to multiple learning styles (e.g., visual, auditory, kinaesthetic) at the same time” (p.90). This can further lead to an increase in student motivation to learn, as technologies that meet students’ differentiated learning styles may allow for students to better connect with and understand the information presented (Ciampa, 2014; Clemens, Moore & Nelson, 2003). In one study, an Ontario school board noted that “they found technology plays an immense role in increasing student engagement and student voice, and is beginning to make a difference in teachers differentiating instruction with both digital and non-digital resources (Beggs et al., 2013, p.25); however, other school boards contrasted these points, arguing that either student engagement had not increased to the extent that had been anticipated, or that “some students were not receptive to the type of technology being used” (Beggs et al., 2013, p.25).

Many technologies also offer opportunities for both individual and collaborative instruction (Ciampa, 2014; Clemens et al., 2003). For instance, in one study, a SMART Board was used in conjunction with mathematics instruction on addition, subtraction, time and coin
identification and counting in a Grade 1 class (Clemens et al., 2003). It was noted that this technology allowed for educators to address the whole class, rather than just a few individual students. Moreover, the introduction of the SMART Board meant that students “had access to full multimedia presentations including animation and sound. Students’ interest levels soared compared to the traditional method of instruction using the overhead and chalkboard” (Clemens et al., 2003, p.2). Results of the study further illustrated that with the use of the SMART Board, the students outperformed a control group and demonstrated “significant growth, academic achievement, and positive attitudes toward the specific skills taught” (Clemens et al., 2003, p.6).

2.1.3 Benefits of technology use for students with autism

Some studies have looked into the impact that computer-assisted technologies (CAT), such as video modeling, games and computer programs, can have on the learning of students with autism spectrum disorders (Ploog et al., 2012). Many students with autism spectrum disorders “often find it difficult to ‘read’ social behavior, and to infer the beliefs and intentions of others” (Xin & Sutman, 2011, p.19). Research has found that computer programs can be beneficial in presenting social stories to students with autism in order to help improve their social and communication skills (Xin & Sutman, 2011). In one particular study, educators used a PowerPoint program on a SMART Board to display social stories that illustrated appropriate behaviours for students with autism (Xin & Sutman, 2011). Results of the study showed that “This computer-assisted practice in learning through social stories was helpful in teaching social communication skills to children with ASD” (Xin & Sutman, 2011, p.21), demonstrating the potential of such technologies to foster inclusion and differentiated learning opportunities for students with autism.
On the contrary, educators must be cautious in using computer-assisted technologies for students with autism spectrum disorders, as many of the available technologies are not designed particularly for the education of individuals with this exceptionality (Ploog et al., 2012). In turn, certain technologies and programs “employ various sounds (bells and whistles) that might unintentionally set the occasion for undesirable behavior or distract from the relevant information to be conveyed” (Ploog et al., 2012, p.319). Moreover, although the intention of utilizing such technologies with students with autism spectrum disorders may be to improve their social and communicative skills, some programs may hinder students in developing these skills if students learn only to interact with the technology itself rather than other people, and some technologies inadvertently encourage students to display “limited acts of behavior and ways of responding to various stimuli (because of the limited range of training situations incorporated in the CAT)” (Ploog et al., 2012, p.319)

2.2 Barriers to Utilizing Technology in Schools

Research cites a number of common challenges that are found to act as barriers to the integration of technology in educational settings. For example, a factor frequently noted as a challenge in integrating technology into classrooms centers around access to and quality of wireless networks in schools. In some studies, it has been noted that network speed, wireless access and blocked sites were all examples of common obstacles that educators often encountered with the use of technology in their schools (Beggs et al., 2013; Bauer & Kenton, 2005). Moreover, one Ontario school board described that “connectivity issues in schools and slow internet not only impede students’ perceptions of their learning experiences, but it impedes teacher willingness to take risks by basing lessons on technology and have them fail due to connectivity problems” (Beggs et al., 2013, p.38), illustrating how common technological issues
can hinder the integration and learning process for both the educators and students involved. On a similar note, teachers in a separate study discussed the challenge that they were responsible for attempting to fix issues with hardware including frozen computers or wiring problems, as there were no technicians supplied to deal with such complications (Bauer & Kenton, 2005). Furthermore, funding for technology is also found to be an issue for many schools that seek to incorporate technology into classrooms. As was noted above, it is often costly to maintain school hardware (Peel District School Board, n.d.). A needs analysis study from Turkey agreed that “investment in the infrastructure of schools including hardware, software, Internet, and maintenance” (Vatanartiran & Karadeniz, 2015, p.216) is an important factor that schools should consider budgeting for, as a lack of funding towards this type of technological support may hinder the integration of technology in education. Finally, a further obstacle stressed by another school board was the added challenge of providing an adequate number of devices for students to utilize (Beggs et al., 2013).

2.2.1 Challenges associated with bring your own device policies

As was mentioned in the preceding section of this paper, Bring Your Own Device policies are being enacted across many Ontario school boards; however this presents a unique set of challenges in itself. For instance, implications such as liability in regards to damage, theft and a loss of content, along with issues surrounding behaviour in terms of appropriate use of devices and levels of distraction, and ensuring that devices are used for instruction rather than entertainment can all be examples of challenges that may surface when students are permitted to bring their own personal technological devices to school (Beggs et al., 2013).

Furthermore, a concern expressed by teachers surfaced regarding issues of equitable access to technology, as students who had access to computers at home or devices that they
could bring to school had a greater advantage of being able to work on assignments, collaborate with other students, or to take additional time to improve their work (Beggs et al., 2013). Current research suggests that 58% of families with incomes below $30,000 and 98% of families with higher income have access to the internet, creating a digital divide in terms of access to technology (Chen et al., 2014). The BYOD policies currently being implemented across the province of Ontario specifically address this issue of equitable access to technology, as students who do not have access to personal technological devices, such as those who are unable to afford their own or those who do not wish to bring their devices into their school, may be supplied with devices from the school itself (Peel District School Board, n.d.).

2.2.2 Teacher training as a barrier to technology integration

One study that surveyed a number of Ontario school boards cited that a common barrier to technology integration in schools is a lack of teacher training and professional development opportunities (Beggs et al., 2013). For instance, some educators explained that it is not enough to be provided with technological tools, but rather that they need to be given guidance in how to use such devices effectively along with sufficient time to collaborate with others (Beggs et al., 2013). Similarly, another study from North Louisiana found that many teachers in the state were “unprepared or disinclined to incorporate computer and other electronic technology into their instructional repertoire” (Leonard & Leonard, 2006, p.221). This was suggested to have resulted from the fact that, in the United States, only fifteen states enforce that preservice teachers take technology courses (Leonard & Leonard, 2006).

The same North Louisiana study also found that a lack of teacher training is not the only factor acting as a barrier to technology integration in schools, but that an overwhelming number of school administrators in the study felt as though they were not familiar with many forms of
technology and, in turn, did not feel as though they were well prepared to “lead technology integration in their schools” (Leonard & Leonard, 2006, p.221). In contrast, it was noted that teachers’ level of comfort and confidence in using technology improved when schools offered opportunities for professional development to a number of educators, thus emphasizing the importance of providing teachers with adequate supports and resources (Beggs et al., 2013).

### 2.2.3 Inconsistencies in the Ontario curriculum

Although the Ontario Ministry of Education appears to be pushing for more inclusion of technology in schools, parts of the Ontario curriculum (Ontario Ministry of Education, 2005) appear inconsistent or ineffective in representing this goal. For instance, in the Ontario curriculum mathematics (OMOE, 2005) document, it is expressed that various tools like calculators, computers and software programs like TinkerPlots and The Geometer’s Sketchpad be used alongside traditional instruction; however, the specific expectations rarely suggest the use of technological devices and software. Moreover, many specific expectations that suggest the use of technology merely state to use computers or calculators. Authors Bennett and Parise (2014) wrote, “Onscreen techniques that merely accommodate rote skills, simplifying access to information alone, can never substitute for students’ genetic inheritance of cognition” (p.368). Connecting with this point, it is essential that students are given opportunities to work with a variety of innovative technologies, rather than simply being provided with calculators to complete mathematical equations. The inclusion of more diverse devices and software in the specific expectations of the Ontario curriculum could therefore benefit student learning if educators were mandated to utilize such resources.
2.3 The Divide: Nature-Deficit Disorder

As the twenty-first century progresses, it is becoming apparent that technology will play an ever-increasing role in both the daily lives and education of many students. The preceding sections of this paper outlined the many benefits that technology may provide for students’ development and education. Although it is clear that technology has the opportunity to make many positive additions to the realm of education, it must also be noted that there are potential negative consequences that come with the increased presence of technology in children’s everyday lives.

One such consequence is addressed by Richard Louv (2005) who authored the book *Last Child in The Woods*, in which he describes the occurrence of what he termed nature-deficit disorder. Louv (2005) explains, “Now we see the emergence of what I have come to call nature-deficit disorder. This term is by no means a medical diagnosis, but it does offer a way to think about the problem and the possibilities – for children and for the rest of us as well” (p.10). Nature-deficit disorder is thus described as “a label used to address the increasing cost to children as they are increasingly deprived of direct contact with nature and the experience of unstructured free play in the out-of-doors” (Driessnack, 2009, p.73), and it is considered to be a direct result of children’s decreasing contact with nature stemming from the increased prominence of electronic technology in today’s society. It is further described that “Atrophy of the senses was occurring long before we came to be bombarded with the latest generation of computers, high-definition TV, and wireless phones…But the new technology accelerates the phenomenon” (Louv, 2005, p.64).

With this increasing trend of nature-deficit disorder in mind, it is imperative that environmental education and natural outdoor experiences are also given priority within the
education system, as there currently appears to be an imbalance between natural and technological experiences for students today. For example, “A large part of students’ recreational hours is spent playing computer games or texting friends through the detachment of an electronic device” (Bennett & Parise, 2014, p.368), and so, it is important to begin looking at how to decrease this imbalance. The following section of this paper will therefore discuss both the benefits and challenges associated with environmental education and natural learning experiences for students.

2.4 Nature-Based Learning and Environmental Education

It is described in *Shaping Our Schools, Shaping Our Future* (Ontario Working Group on Environmental Education, 2007) that “Schools have a vital role to play in preparing our young people to take their place as informed, engaged, and empowered citizens who will be pivotal in shaping the future of our communities, our province, our country, and our global environment” (p.1). In order to best support students in becoming successful in the future and to combat what Louv (2005) refers to as nature-deficit disorder, it is important that students have a balanced education that seeks to connect them with their own communities and opportunities to engage in authentic learning experiences. The following sections of this paper will thus describe Ontario policies put in place to support environmental education and natural outdoor learning experiences, along with the benefits and barriers to implementing such experiences in an educational context.

2.4.1 Policies that support the integration of nature in schools

This section will seek to explore three policies within Ontario that help to support the integration of nature-based education in schools. Specifically, the Ontario curriculum (OMOE, 2007) will be reviewed to discuss how it aims to address environmental education within
schools. Next, brief overviews of policy documents including *Shaping Our Schools, Shaping Our Future* (Ontario Working Group on Environmental Education, 2007) and *Acting Today, Shaping Tomorrow* (OMOE, 2009) will be provided in order to speak to some of the overall visions and goals surrounding environmental education.

### 2.4.1.1 The Ontario curriculum

As with technology, the Ontario curriculum (OMOE, 2007) plays an impactful role in supporting the integration of nature and environmental education in school settings, as it emphasizes the importance of encouraging students to develop an understanding of and a connection to the environment and natural systems. Cross-curricular learning, which is described as providing students “with opportunities to learn and use related content and/or skills in two or more subjects” (OMOE, 2007, p.30), is also a critical objective that the Ontario curriculum highlights, stating that “the Ministry of Education is working to embed environmental education expectations and opportunities in all grades and subjects of the Ontario curriculum” (Ontario Ministry of Education, 2011, p.3).

The Ontario curriculum science and technology (OMOE, 2007) document outlines several fundamental concepts that students are meant to gain a deeper understanding of as they progress through the science and technology curriculum. It is important to note that this section of the curriculum explicitly outlines fundamental concepts related to nature and environmental education, including the key ideas of “systems and interactions”, which relates to the functions of and relationships between both living and non-living natural and human systems, and “sustainability and stewardship”, which encompasses renewable and non-renewable resources along with “meeting the needs of the present without compromising the ability of future generations to meet their needs” (OMOE, 2007, p.5). These concepts are significant in that they
outline expectations regarding environmental education that educators are mandated to teach, further demonstrating the Ministry’s ever-increasing support for nature and environmental education.

2.4.1.2 Shaping Our Schools, Shaping Our Future

The Ontario Working Group on Environmental Education (2007) developed a report entitled Shaping Our Schools, Shaping Our Future. This report noted that, although the Ontario curriculum included elements of environmental education, “In the absence of a comprehensive framework for environmental education…these efforts remain fragmented and inconsistent” (Ontario Working Group on Environmental Education, 2007, p.1). In order to better support students in becoming actively environmentally conscious and responsible citizens, the report identified key priorities and a list of thirty-two recommendations for incorporating environmental education more holistically into the Ontario curriculum (Ontario Working Group on Environmental Education, 2007). Currently, the Ontario government is attempting to implement the thirty-two recommendations suggested in the report and ensuring that environmental education is properly incorporated across the curriculum (OMOE, 2009, p.3).

2.4.1.3 Acting Today, Shaping Tomorrow

Acting Today, Shaping Tomorrow (OMOE, 2009) is a framework that builds off of the ideas surrounding environmental education that were described in the Shaping Our Schools, Shaping Our Future (Ontario Working Group on Environmental Education, 2007) report. This framework outlines the Ontario Ministry of Education’s policy for environmental education and it also seeks to “facilitate the implementation of programs and curriculum initiatives to deepen and broaden student learning about the environment and will help guide school boards’ efforts in putting environmentally responsible practices in place” (OMOE, 2009, p.8). Moreover, a goal of
this document is to “guide school boards and schools towards the development of the skills and knowledge needed to implement environmental education in a community-centred context” (OMOE, 2009, p.4) while addressing “the differing environmental, social, and economic conditions that exist in Ontario communities” (OMOE, 2009, p.8). The document also describes goals regarding teaching and learning, student engagement and community connections, and environmental leadership. In outlining these goals, the document further provides research that backs some of the benefits of environmental education and natural experiences, some of which that will be referred to later in this paper (OMOE, 2009).

2.4.2 Academic benefits associated with nature and environmental education

There are numerous benefits associated with environmental education and nature-based learning experiences. First, such experiences have been found to nurture student engagement and also to increase academic achievement, as students are challenged to enhance their critical thinking skills, along with their ability to solve problems (OMOE, 2009). Another benefit is that, similar to technology, environmental education and nature are subjects that are lent well to cross-curricular exploration across various subjects, as aspects of environmental education can be addressed through language, math and art (OMOE, 2007). As an example, one study determined that there are many opportunities for combining environmental education and art together in the form of eco-art, such as through the consideration of waste reduction and use of found objects or biodegradable materials during the process of making art, as well as holding discussions about environmental ideas and issues represented in art (Inwood, 2010). For instance, one educator in the study shared a classroom experience with discussing artists like Emily Carr, as students inquired into her artwork and the materials she used to contemplate whether or not she would be considered an eco-artist. A second educator spoke to her classroom’s use of natural materials like
branches and leaves to create ice sculptures during the winter which would then decompose in
the school garden during the coming months (Inwood, 2010). Furthermore, a separate study
showcased cross-curricular connections between nature and mathematics, as students were
tasked with gathering and analyzing data to measure the volume and circumference of animal
burrows (Crowe & Boston, 2004). It was explained that the “main objectives of this activity are
for students to see that living organisms need nonliving components of the ecosystem to survive
and that the subjects of math and biology intersect” (Crowe & Boston, 2004, p.34). These are
just a few examples of the many ways in which nature and environmental education can be
connected with other curriculum subjects.

As was previously mentioned, the Acting Today, Shaping Tomorrow (OMOE, 2009)
document described the importance of providing students with knowledge of community-based
environmental education. Similarly, the previous Shaping Our Schools, Shaping Our Future
(Ontario Working Group on Environmental Education, 2007) report noted that, to achieve this
goal, providing students with outdoor educational experiences in conjunction with traditional
environmental education can help to “foster a connection to local places, develop a greater
understanding of ecosystems, and provide a unique context for learning” (p.6). Authors Tan and
Pedretti (2010) also discussed that teachers who addressed local environmental issues in their
practice found an increase in both “student enthusiasm and involvement” (p.65). Aligning with
this research, the Ontario curriculum (OMOE, 2007) emphasizes that teachers have opportunities
to take students outside in order to engage them in authentic learning experiences that connect
students to their local communities and real issues. In turn, environmental education then has the
ability to help students to “understand the nature and complexity of environmental challenges
and builds their capacity to take appropriate action” (OMOE, 2009, p.3).
2.4.3 Health and physical benefits of natural outdoor experiences

Aside from academic benefits, there are also various physical and health-related advantages that are associated with nature. For instance, Richard Louv (2005) argues that “Children need nature for the healthy development of their senses, and therefore, for learning and creativity” (p. 54). Further, he provides insight into a possible link between nature and depression, citing research that notes “Although exposure to nature may have no impact on the most severe depressions, we do know that nature experiences can relieve some of the everyday pressures that may lead to childhood depression” (Louv, 2005, p. 48). Similarly, a study from the United States looked at the impact of a wooded area, an outdoor classroom, and gardening programs on elementary and high school students. The authors, Chawla, Keena, Pevec and Stanley (2014) observed that “natural areas served as places where young people could find refuge from stress and develop protective factors for resilience in the form of supportive relationships and a sense of competence” (p. 1). Moreover, Louv (2005) discussed a Swedish study by Grahn, Martensson, Lindblad, Nilsson and Ekman that compared the impact that two different daycare environments had on young children. Tall buildings surrounded the first setting while, by contrast, the second setting was located in an orchard near a pasture and a wooded area next to a garden, trees, and rocks. The children who were given opportunities to play outside every day in the orchard setting were found to have more well-developed motor and concentration skills (Louv, 2005). This research thus helps to highlight the potential health implications for introducing students to natural, green spaces.
2.4.4 Benefits of natural experiences for students with attention deficit hyperactivity disorder

In the U.S. ADHD is one of the more prevalent mental disorders that children suffer from (Louv, 2005). Author Richard Louv (2005) describes that “Children with the syndrome are restless, and have trouble paying attention, listening, following directions, and focusing on tasks. They may also be aggressive, even antisocial, and may suffer from academic failure” (p.99). He then goes on to argue that “Although today’s common medications for ADHD offer temporary gains, including sustained attention and academic productivity, these medications may do little for a child’s long-term success, either socially or academically” (Louv, 2005, p.107), and he states that natural experiences may have the potential to decrease attention deficits in children.

Louv’s (2005) suggestion is supported by the research of Faber Taylor and Kuo (2009) who conducted a study in which children with ADHD were taken for walks in a downtown setting, a neighbourhood setting, and a park. It was discovered that, after walking in the park setting, children with ADHD had improved concentration, more so than they did after walks in the more urban environments (Faber Taylor & Kuo, 2009). Moreover, the effects of walking in the more natural environment was “roughly equal to the peak effects of two typical ADHD medications” (Faber Taylor & Kuo, 2009, p.405). A second survey from the Netherlands found similar results to that of what Faber Taylor and Kuo (2009) described. In this study, six children with ADHD were observed in both a small town setting and a wooded area, followed by completing a concentration task. The children were found to have higher levels of concentration after visiting the wooded area, and they appeared to display “somewhat more non-social, aggressive, inattentive, impulsive and hyperactive behaviour in the town than in the woods”
(Van Den Berg & Van Den Berg, 2010, p.430), falling in line with Louv’s (2005) proposal that nature may be highly beneficial for children with ADHD.

2.5 Barriers to the Inclusion of Natural Experiences in Schools

A major challenge that was addressed as a barrier to incorporating nature into educational experiences was the lack of teacher training in this area. For instance, the Ontario Working Group on Environmental Education (2007) discussed that “Few faculties of education offer environmental education as a teachable subject, or offer specialized programs in environmental studies for teacher candidates” (p.2). Furthermore, this lack of teacher training in environmental education, in conjunction with the fact that there are not many specific expectations regarding environmental studies in the Ontario curriculum, may be contributing to “a gap between the environmental education ‘intended’ in Ontario’s curriculum and that which is taught and received in the classroom” (Ontario Working Group on Environmental Education, 2007, p.2). This is consistent with findings from a Nova Scotia study which details that, of the eighteen sixth grade teachers interviewed, only three specified having been instructed about the environment or how to teach environmental education, five indicated some instruction on the environment in their training, and ten received no training in environmental education (Spence, Wright & Castleden, 2013).

Several other obstacles were listed as impeding the inclusion of environmental education and nature in schools, including an overcrowded curriculum (Spence et al., 2013; Tan & Pedretti, 2010), access to outdoor learning environments (Ernst, 2014; Spence et al., 2013; Tan & Pedretti, 2010), and difficulties in teaching environmental education across the curriculum (Spence et al., 2013; Tan & Pedretti, 2010). Another study in an early childhood education setting addressed that “lack of time, winter weather, safety concerns, and lack of extra
supervision” (Ernst, 2014, p.746) were other common barriers to utilizing outdoor spaces. Ernst (2014) also proposed that educators’ perceptions of natural settings may be a barrier to utilizing such spaces, as educators may perceive that there is a lack of access to outdoor spaces on the grounds and they may not associate certain local spaces with natural outdoor learning settings.

2.6 Bridging the Divide: Using Technology to Enhance Natural Learning Experiences

The paper thus far has been dedicated to showcasing the various benefits and challenges of incorporating both technology and natural experiences into the education system. Up until this point, the two topics have been addressed separately; however, I would argue that it would be advantageous to begin to look at both technology and nature as complementary instructional tools. The remainder of this paper will therefore discuss the positive potential for student learning that could result from an integrated approach to utilizing technology to enhance natural outdoor experiences and environmental education.

2.6.1 A review of technology currently in place to support natural learning experiences

One interesting study that assists in highlighting the potential implications of integrating nature and technology together consisted of taking fifty-five Grade 5 students from low-income schools on nature hikes (Boyce et al., 2014). The students were provided with iPads which they used as a reference for information and collecting data in the form of digital photographs and taking notes (Boyce et al., 2014). The results suggested that the students remained engaged throughout the nature hike, and they also displayed an interest in “returning to the site and responded positively toward interacting with nature” (Boyce et al., 2014, p.815). This study offers interesting insight into the idea that technology can be used to enhance natural experiences and to help students reconnect with the outdoors, as it was suggested that “the incorporation of
field-friendly technology that engages students with nature, not technology alone, is a useful tool for keeping students interested in science” (Boyce et al., 2014, p.815).

Another important area to review in regards to the integration of technology and nature is that of augmented reality. Several studies have looked into the impact of augmented reality on students’ learning and engagement (Chiang, Yang & Hwang; Kerawalla, Luckin, Seljeflot & Woolard, 2006; Tarng, Ou, Yu, Liou & Liou, 2015; Yoon & Wang, 2014). Further, these studies have had varied results that suggest that there may be potential for augmented reality to bridge the gap between technology and nature in education; although, both benefits and challenges were discussed in the research. As an example, a school in Taiwan utilized augmented reality and mobile technologies including smart phones and tablet PCs to create a virtual butterfly garden (Tarng et al., 2015). Students used mobile technologies to “breed virtual butterflies on host plants and observe their life cycles at different growing stages” (Tarng et al., 2015, p.1). The study revealed that most students found the virtual garden to be interesting, convenient, and realistic, and that it “could improve their learning effectively” (Tarng et al., 2015, p.16). Tarng et al. (2015) also suggested that the virtual garden “is easy to develop and maintain, and it can solve the problems of insufficient butterfly species and quantity” (p.16), and further, that the system was “not limited by time or space, and students can learn about butterfly ecology in their familiar environments” (p.16). This point is important in relation to Ernst’s (2014) earlier suggestion that some educators may perceive having a lack of nature in their local environments, as the use of augmented reality may help to combat this perception, allowing educators to integrate nature into their own classrooms. A second study of augmented reality involving students in Grades 5 to 7 found that the devices fostered interaction, engagement and collaboration, as students were able to “connect their creative play with science content” (Yoon
& Wang, 2014, p.54). In contrast, Kerawalla et al. (2006) conducted a different investigation of augmented reality that suggested some students using the technology “were less engaged than those using traditional resources” (p.163), pointing to the idea that augmented reality may not be successful in a classroom setting if not implemented effectively.

2.6.2 Future directions: the potential to modify existing technologies to enhance nature

As cited earlier, the Ontario curriculum (OMOE, 2007) plays a valuable role in supporting the inclusion of both technology and environmental education in schools. The Ontario curriculum science and technology (OMOE, 2007) document states expectations for “relating science and technology to society and the environment (STSE)” (p.11) and elaborates that these expectations “set the context for developing the related skills and conceptual knowledge that are necessary for making connections between scientific, technological, social, and environmental issues” (p.11). These quotations may thus help to suggest the Ministry’s commitment to the integration of technology and environmental education.

Furthermore, the Ontario Software Acquisition Program (OSAPAC, 2014/2015) website mentioned previously contains sample lesson plans, one of which in particular is aimed at incorporating the Ministry-licensed resource BookFlix into a science lesson about air and water (Signer, n.d.). This resource shows the potential for integrating technology and nature together in education, and so, educators in the future, in conjunction with a continued commitment for STSE from the Ontario Ministry of Education, may seek more innovative Ministry-licensed technologies that blend well with the environmental education expectations.

To continue, the twenty-first century currently houses an abundance of technological devices and software, many of which are slowly being integrated into school settings and some of which that may, in the future, make a promising addition to the field of education and, in
particular, to environmental education. Further research is needed to determine the extent to which technology can be used to enhance nature and environmental education. As is referenced in *Acting Today, Shaping Tomorrow* (OMOE, 2009), schools are asked to “encourage students to enrich their learning by using information technology to access resources, connect with others, and create e-communities that focus on environmental issues” (p.15). This, therefore, emphasizes one of the many simple actions that can be taken to encourage the use of technology to empower nature and environmental education. Additional research on devices and software including virtual reality, online blogs and various forms of social media may further help to enlighten future directions for bridging the divide between technology and nature in an educational context.

### 2.7 Conclusion

This literature review analyzed some of the current research surrounding the usefulness of and challenges to incorporating technology and natural learning experiences into the education system. Further, this review attempted to investigate relevant literature in the area of technology and nature integration with the intention of examining the potential for technology to enhance natural experiences and environmental education. The research highlights that there are several benefits of both technology and nature for the academic and healthy development of students. There is also an abundance of research pointing to the many limitations and challenges in incorporating nature and technology in schools, including issues surrounding funding and a lack of resources, teacher training and teacher perceptions. Based on the information reviewed in this paper, it is clear that the Ontario Ministry of Education, along with other school boards around the world, is pushing to include a balance of both technological and natural learning experiences for its students; however, as may be inferred from the research, there are still many areas for
future direction that still need to be addressed in regards to this topic, including the types of available technologies that may be beneficial in enhancing environmental education, as well as whether or not the integration of nature and technology will be successful and advantageous for students. My study therefore aims to address such concepts and to provide insights into how elementary level educators are currently working to integrate nature-based education and technology together in their own practice, such as by inquiring into their teaching practices, available resources, and student outcomes.
Chapter 3: Research Methodology

3.0 Introduction

In this chapter, I describe the research methodology involved in my study. I begin by reviewing the research approach, procedures and instruments of data collection. I then discuss information in relation to study participants, including sampling criteria, participant recruitment and participant biographies. Following this, I explain data analysis procedures and I outline the ethical review procedures that are applicable to my study. I then identify both the methodological limitations of this study as well as the strengths of the methodology. To conclude, I provide a brief summary and rationale of key methodological decisions given the research purpose and questions designed for this study.

3.1 Research Approach and Procedures

For the purposes of this research, this study has been completed using a qualitative research approach. This involved conducting a review of current literature and research relevant to the research purpose and questions of the study, as well as semi-structured interviews with two to three educators who were currently working within the field of education. Taking a qualitative approach to research may often be more appropriate when “quantitative measures and the statistical analysis simply do not fit the problem” (Creswell, 2012, p.48) and because such quantitative “measures may not be sensitive to issues such as gender differences, race, economic status, and individual differences” (Creswell, 2012, p.48). Similarly, Miles and Huberman (1994) noted that qualitative data allows the researcher to “preserve chronological flow, see precisely which events led to which consequences, and derive fruitful explanations” (p.1), and it is explained that “Words, especially organized into incidents or stories, have a concrete, vivid,
meaningful flavor that often proves far more convincing to a reader – another researcher, policymaker, a practitioner – than pages of summarized numbers” (p.1).

As is expressed by Creswell (2012), qualitative research is used when there is an issue that requires exploration “because of a need to study a group or population, identify variables that cannot be easily measured, or hear silenced voices” (p.48). Creswell (2012) further goes on to state that qualitative research is useful in gaining a more detailed understanding of the problem at hand, and “This detail can only be established by talking directly with people, going to their homes or places of work, and allowing them to tell the stories unencumbered by what we expect to find or what we have read in the literature” (p.48). In these ways, a qualitative research approach was suitable for my research given the purpose and questions of this study, as it allowed me to explore the challenges associated with integrating nature and technology together in educational settings as described by educators currently working towards this goal in the field. Obtaining educators’ first-hand accounts of this task thus helped to provide a deeper understanding of how teachers are integrating nature and technology together in education, as well as the outcomes that they have observed in their students over a period of time in relation to learning and engagement.

3.2 Instruments of Data Collection

Given the parameters of the Master of Teaching Research Project, the only instrument of data collection for this research study was a semi-structured interview protocol (Appendix B). Unlike structured interviews which are often used in quantitative studies, semi-structured interviews are more frequently used in qualitative studies (DiCicco-Bloom & Crabtree, 2006). Semi-structured interviews are commonly organized according to open-ended questions that are predesigned by the researcher (DiCicco-Bloom & Crabtree, 2006); however, such interviews can
also allow for some flexibility for the participant to expand on topics that the researcher may not have originally foreseen, thus providing the potential for obtaining additional data that may be significant to the study’s findings (Carr, 1994).

The interview protocol (Appendix B) for my study is organized into five distinct sections: the participant’s background information, the teacher’s perspectives and beliefs surrounding the integration of nature and technology together in educational settings, the educator’s practices, supports and challenges that the educator has faced in integrating nature and technology, and next steps for educators in this area of study. Each semi-structured interview lasted between 45 to 60 minutes, depending on the amount of additional content that arose and was discussed spontaneously throughout the interview.

### 3.3 Participants

In this section of the chapter, I address all methodological decision-making pertaining to my research participants. First, I begin by reviewing the sampling criteria that I established for obtaining participant recruitment, and I then outline possible avenues for teacher recruitment. Further, I have also included a section wherein I introduce each of the participants of my study.

#### 3.3.1 Sampling criteria

The following is a list of the criteria that were applied to teacher participants:

- Educator must have a minimum of three years of experience working with students from kindergarten to Grade 8
- Educator must be employed within the Greater Toronto Area (GTA) in Ontario, Canada
- Educator must have access to various forms of technology (SMART Board, computer, camera, iPad, etc.)
• Educator must have access to an outdoor space or natural setting (park, forest, field, garden, etc.)

• Educator must have a dedicated commitment to integrating nature and technology together in an educational context

In order to address the main research question of my study, the participants recruited were required to meet the abovementioned criteria. Educators were expected to have worked with students from kindergarten to Grade 8 for a minimum of three years, as the main target student population of my research falls within this age range, and a minimum of three years of experience teaching these students may allow educators to speak more assuredly about the observed outcomes in relation to learning and engagement, or lack thereof, in students as a result of integrating nature and technology-based experiences together. Educators were also expected to be employed within the GTA in order to limit the scope of the research study and to increase my likelihood of being able to conduct face-to-face interviews with participants. I also specified that participants must have had access to different types of technology and natural outdoor settings, combined with a dedicated commitment to integrating nature and technology together in their practice. These criteria were essential for the purposes of this study, as educators needed access to such resources in order to report on the outcomes observed in students who had been given opportunities to interact with both nature and technology together, and educators who had demonstrated a commitment to integrating nature and technology together may have been able to speak more openly, honestly and specifically about how they have done so, the outcomes they have observed in their students, and the challenges they have encountered in the process.
3.3.2 Sampling procedures and recruitment

Due to the small-scale nature of this research study and the limitations in place for the Master of Teaching Research Project, my sampling procedure relied mostly on that of convenience sampling, which “involves drawing samples that are both easily accessible and willing to participate in a study (Teddlie & Yu, 2007, p.78); although, there were some aspects of purposive sampling present in the recruitment process. As I was immersed in a community of teacher colleagues and mentor teachers, as is the nature of the educational program that I was enrolled in, I mainly relied on my existing contacts and networks to recruit participants for this study, thus taking a primarily convenient approach to sampling. In relation to the participant criteria established for my study above, the conditions outlined represent purposive sampling, which “may be defined as selecting units (e.g., individuals, groups of individuals, institutions) based on specific purposes associated with answering a research study’s questions” (Teddlie & Yu, 2007, p. 77).

To continue, a specific strategy that I used to garner participants for my study was to contact teacher associations, school boards, and principals and provide them with an overview of my research study. I provided the participant criteria and asked that those individuals and organizations distribute my information to teachers they believed may have fulfilled the criteria. I provided my information rather than asking those individuals and organizations to provide me with the names and contact information of people they thought would be suitable. That would have helped to ensure that teachers were volunteering to participate rather than feeling pressure or obligation to participate, a tactic that relates to volunteer convenience samples, as described by Teddlie and Yu (2007).
3.3.3 Participant bios

The first interview participant in my study is referred to under the assigned pseudonym Carol. Carol is a Grade 3 and 4 split classroom teacher in an elementary school in the Greater Toronto Area. Carol has been a teacher for thirteen years and has taught all grades from kindergarten to Grade 4. Being a primary/junior teacher, she is also responsible for teaching a number of subjects in her classroom including art, math, language, and science. Aside from her role as a classroom teacher, Carol also sits on the school council as well as committees for the school improvement plan, and she is responsible for many of the eco-initiatives in her school. She first became involved in eco-initiatives at her school as a new teacher when a colleague recruited her to help lead the school’s eco team, and for approximately the past ten years, Carol has been integrating nature-based teaching in her practice. As for technology, Carol admits that she has always been comfortable using technology, as she has a background in radio and television, and she has been integrating technology in her practice for her nearly thirteen years as a teacher. When asked about when she began to bring nature-based education and technology together in her practice, Carol explained that she has been doing so for the past couple of years since her school made technologies like iPads available to educators.

The second interview participant in my study is referred to under the pseudonym Emily. Emily has been a certified educator for the past five years, but she has worked within the field of education for a total of nine years. Emily currently works as both an education technician and a festival coordinator at an outdoor education centre in the Greater Toronto Area. The centre delivers environmental education programming to students from kindergarten through to Grade 8, teaching to all subject areas; however, there is a greater focus on science as well as some specialized art programs. Contributing to her interest in and preparation for nature-based
learning, Emily’s undergrad was in geography, and in teacher’s college her focus class was in environmental education. She also completed an alternative practicum at a nature centre in Hawaii, and she expressed that the experience largely contributed to her inspiration for creating nature-based programs in her own practice. For the past two and a half years, Emily has been integrating technology into her nature-based programming, as the outdoor education centre that she works at recognized the growing availability of various technologies. She explained that she thinks there is potential for increasing the integration of nature-based education and technology together.

3.4 Data Analysis

This section of the chapter focuses on how I analyzed the data collected throughout the research study. Miles and Huberman (1994) discussed that good qualitative data “help researchers to get beyond initial conceptions and to generate or revise conceptual frameworks” (p.1), and through analysis of the data that I collected during participant interviews, new insights were gained in regards to the feasibility and possible benefits of the integration of nature-based education and technology together. Prior to analyzing my data, I transcribed the participant interviews that I conducted. From there, I coded my transcripts using the research questions I designed as an interpretive tool. I coded each transcript individually and identified categories of data and themes within categories. According to Miles and Huberman (1994), coding is a step in analysis that requires the researcher to “differentiate and combine the data” (p.56) gathered and to reflect on the information in relation to the research question. As a second level, I read the categories and themes beside one another, synthesizing themes where appropriate. As was explained by Saldaña (2009), that cycle of “recoding further manages, filters, highlights, and focuses the salient features of the qualitative data record for generating categories, themes, and
concepts, grasping meaning, and/or building theory” (p.8). A later stage of analysis was the meaning-making process whereby I spoke to what matters about those themes given what existing research from my literature review had already found. Moreover, I also looked at “null data” that study participants did not speak to, and I elaborated on why that data is significant.

### 3.5 Ethical Review Procedures

There are no known risks associated with participation in this research study; although Hegney & Chan (2010) suggested that all types of research involve some element of risk. Therefore, in order to minimize any possible risk, there were a number of ethical review procedures that I followed during this study. This section of the chapter thus serves to elaborate on the steps that were taken to minimize any potential risks to participants.

First, participants were all asked to sign a consent form (Appendix A) to give their consent to be interviewed and audio-recorded. The consent letter provided an overview of the study, addressed ethical implications, and specified the expectations for participation. Participants were made aware of their right to choose not to answer any interview questions that they did not wish to answer, and they were also notified of their right to withdraw from participation in the study at any stage of the research study until it was published.

To continue, all study participants were assigned a pseudonym so as to further maintain privacy and confidentiality. Any identifying markers related to the participants’ positions, schools or students were also excluded from this research study in order to ensure that participants are unable to be identified. As is explained by Creswell (2012), qualitative research is valuable in that it allows for researchers to collaborate with participants, such as “by having them review our research questions, or by having them collaborate with us during the data analysis and interpretation phases of research” (p.48), thus minimizing the power relationships
that may develop between researchers and participants. For this reason, once the interviews were completed, participants then had the option to review the transcripts and to clarify or retract any statements before I conducted data analysis. Further, all data, including audio-recordings of the interviews, will be stored on my password protected laptop for a period of five years, after which it will be destroyed.

3.6 Methodological Limitations

Throughout this section of the chapter, I speak to both the methodological limitations and strengths of this research study. First, considering the ethical limitations imposed on the Master of Teaching Research Project, the semi-structured interviews used to collect data for this study were only permitted to be conducted with teachers and, consequently, I was unable to interview parents or students, or to conduct surveys or classroom observations. As Creswell (2012) noted, a benefit of qualitative research is that it can be used to address multiple perspectives from a number of individuals who have experiences relevant to the topic being studied. Thus, because the scope of this particular study was limited to interviewing a small number of teachers, the ability to generalize the data to a larger population was then lessened. Secondly, time operated as another constraint in conducting this study. As this research study was being completed as part of the Master of Teaching Program, the entire study was required to be completed within the two year time frame. That time frame, coupled with the heavy workload of the program, sought to limit the scope of the study.

Furthermore, Carr (1994) addressed a number of weaknesses related to qualitative research. For instance, it was argued that the relationship between researchers and participants, and the presence of researchers during the interview process, may affect the participants being studied and distort the study’s findings. Secondly, Duffy explained that qualitative research “is
under-standardized and relies on the insights and the abilities of the observer, thus making assessment of reliability difficult” (as cited in Carr, 1994, p.719).

Although the above paragraphs spoke to the many methodological limitations of this study, it must be noted that there were, too, strengths to utilizing the qualitative approach to research for the purposes of this study. For example, the flexibility of the semi-structured interview may have allowed for participants “to raise issues and topics which the researcher might not have included in a structured research design, adding to the quality of data collected (Carr, 1994, p.718). Moreover, it may be argued that qualitative methodologies have a higher level of validity than quantitative methods, in part due to the fact that participants in qualitative research are often studied in their natural environments, and researchers, being “immersed in the context and subjective states of the research subjects” (Carr, 1994, p.719), are given the ability to determine whether the data reported is consistent with the observations made. Lastly, as I interviewed educators who had demonstrated some dedicated commitment to integrating nature and technology together in educational settings, a strength of the approach was that a deeper understanding of how to achieve the integration of nature and technology in schools, as well as of the challenges and benefits associated with such a feat, were gained.

3.7 Conclusion

In conclusion, throughout this chapter, I described the research methodology involved in my study. I began by reviewing the research approach and procedures, describing the significance of qualitative research in relation to quantitative research. I then discussed the instruments of data collection, recognizing that a semi-structured interview protocol was the only source of data in my study, while also noting the value in conducting semi-structured interviews in relation to the purpose and questions of my research study. Next, I identified the participants
of the study, describing the criteria used to select study participants and providing a brief introduction for each participant involved in my study. For example, each participant was required to meet a series of criteria including having worked in the GTA with students from kindergarten to Grade 8 for a minimum of three years, as well as having a commitment to integrating nature-based education and technology together in their practice, and access to various technologies and outdoor or natural settings. In this section, I also identified the recruitment procedures that were used to obtain study participants, describing the use of both purposive and convenience sampling to recruit interviewees. That method of recruitment was appropriate as I had connections with many elementary-level educators in the field who were potential candidates for interviews. Moving forward, I explained how I analyzed the data obtained from this study, transcribing each interview and identifying themes as well as null data and speaking to the significance of this information. I then addressed the ethical issues involved in this study, speaking to matters of consent, risks of participation, member-checks, the right to withdraw from the study and to choose not to answer interview questions, and the storage and destruction of data. A discussion about how these risks were minimized throughout the study also ensued. Finally, I wrote about the methodological limitations and strengths of this research study in relation to qualitative research approaches. In the next chapter, I report on the findings of the research study.
Chapter 4: Research Findings

4.0 Introduction to the Chapter

In this chapter, I will present and discuss findings drawn from the data analysis of semi-structured qualitative interviews that I conducted with two educators who integrate nature-based education and technology together in their teaching practice. The purpose of this research is to uncover information from the interviews that will provide context to my main research question, “How is a small sample of primary/junior educators in Canada integrating nature-based learning and technology together to support students’ learning and development, and what outcomes do they observe from students?” Throughout the discussion, connections will be made between participants’ experiences with nature-based learning and technology integration and the research uncovered in the Chapter 2 literature review section of this paper. The findings are organized into three main themes:

1. Educators recognized that there are many benefits associated with the integration of nature-based education and technology for students in relation to academic applications, socio-emotional development, and engagement

2. Educators cited that program goals, staff initiative, and access to resources are necessary for the successful integration of nature-based education and technology

3. Educators interviewed agreed that there are challenges and barriers associated with resources and staff initiative that stand in the way of integrating nature-based education and technology together in their practice

The themes are further broken down into subthemes that describe educators’ specific experiences with integrating nature-based education and technology. At the beginning of each theme, I start by explaining what the theme is, report participant data, and then discuss how each
theme relates to existing research. Finally, I conclude by summarizing the discussion and the significance of my findings.

4.1 Educators Recognized That There Are Many Benefits Associated with the Integration of Nature-Based Education and Technology for Students in Relation to Academic Applications, Socio-emotional Development and Engagement

Participants discussed various outcomes and benefits associated with the integration of nature-based education and technology together in their practice. Specifically, participants spoke of benefits in relation to possibilities for applying nature-technology integration in academic contexts, positive growth in students’ social-emotional development, and student engagement. I will begin by discussing participants’ understandings of the role of inquiry and cross-curricular connections through nature-technology integration, followed by their perceptions of how citizenship and inclusion are promoted through such integration. Finally, participants’ connections between nature-technology integration and student engagement will be explored.

4.1.1 Participants acknowledged that the integration of nature-based education and technology together fosters inquiry-based learning and allows for educators to create cross-curricular connections

During the interviews, participants were questioned about whether they had observed academic outcomes in their students as a result of integrating nature-based education and technology together. Carol replied that she was unsure if there were any direct links between students’ academic success and the integration of nature-based education and technology, as she believes that the students experience a growth throughout the years; however, she did note that, with such experiences, her students come out of school with a better understanding of the world around them, as well as with a deeper respect for the environment. Although participants did not
highlight correspondence between students’ academic outcomes and nature-technology integration, they did address their ability to make academic connections within their programming. More specifically, participants acknowledged that the integration of nature-based education and technology supports aspects of inquiry or experiential learning for students, and that such an integration also allows for educators to create a variety of connections across the curriculum in various subject areas.

When speaking to the purpose of technology in nature-based learning, Carol stated that “teachers don’t have all the answers and I think, you know, nowadays teachers are there more to facilitate student learning, not necessarily to tell you the answers.” She elaborated that the use of technology thus supports the inquiry-based framework that many students follow, such as by allowing students to use various technologies like computers or iPads to conduct research that will help to answer their inquiries like “what tree is that? Why does it have a pod?” In this way, students further their own learning about numerous environmental topics, rather than relying on a teacher to supply them with answers. Emily shared similar thoughts with regards to the experiential learning aspect of nature-based education in her own programming, asserting that students “get to experience nature first hand. They’re interacting with it, they’re learning from it, getting dirty from it. And to me, having that connection helps with nature-based learning.” Carol elaborated that technology is particularly useful for recording student findings and thinking while on nature walks, such as through the use of the digital cameras that each class has access to. She further explained that such technology is beneficial in bringing that learning back into the classroom and that it allows for students and educators to engage in class discussions about their findings following outdoor excursions.
Both participants also discussed how they created cross-curricular connections between nature-based education and technology integration and various academic subjects. As an example, Carol shared that she made connections between technology, nature and the art curriculum, as she invited her students to look for different lines in nature while recording their findings using cameras or iPads. Emily described a similar program at her centre in which students were equipped with digital cameras to take nature photography and learn about the seven elements of design in art.

Carol further touched upon another experience in which she created a cross-curricular connection involving social studies, as the topic of communities could be linked with the exploration of natural resources necessary in all communities, such as food and water. Emily’s centre also incorporated science into many of its nature-based programs, such as by examining biodiversity, ecosystems, “things that eat, breathe and grow”, and conducting tree or water studies. Emily later briefly addressed that there were many benefits for students not directly related to curriculum expectations that resulted from a nature-based geocaching program run at the centre. For instance, the program involved students using digital GPS units to locate caches throughout the centre’s property, and it included aspects of “health and fitness because the geocaches are hidden everywhere. We say don’t run, but the kids are always running everywhere.” Moreover, students learned mapping and problem solving skills in order “to find the most efficient way to get from point A to point B using GPS systems without going off of the paths in the forest.”

The learning experiences that Carol and Emily described are aligned with many of the expectations outlined in the Ontario curriculum (OMOE, 2007) that suggest using technology to create cross-curricular connections throughout many subjects. Through the integration of nature-
based education and technology, both participants were able to provide students with opportunities to learn skills and content across numerous subjects including art, science, social studies, health and fitness, as well as media and language which will be discussed in further subthemes. Furthermore, Carol described using iPads to support student inquiry, similar to a case study conducted by Boyce et al. (2014) in which students used such devices to research information and take photographs and field notes. All of these examples serve to highlight the potential for utilizing and applying technology within an academic context.

4.1.2 Participants discussed that the integration of nature-based education and technology helps to foster citizenship and inclusion amongst students

Each participant reported social-emotional benefits for students in relation to nature-based education and technology. First, participants explained that a notable outcome of integrating nature-based education into their programming was that it fostered citizenship amongst students. Participants expressed the significance of starting to teach students about nature-based education when they are young so that they learn early on about the importance of protecting the planet and gaining a deeper appreciation for what exists. For instance, both Carol and Emily stated that helping students to understand that every human action has an impact, either positive or negative, is a big part of citizenship. For this reason, Carol’s school focuses on helping students to understand natural systems and the importance of taking care of them so that the earth is left in good shape for future generations. She spoke to the fact that many students in the school are protective of one of the school gardens, particularly because they put time and effort into caring for the plants in it.

Another benefit that Carol discussed was that integrating nature-based education and technology together creates a sense of inclusion for students with exceptionalities. Specifically,
she spoke to the idea that “any students too that have any learning disabilities, technology is such a great resource for them because they can speak into it instead of writing out their thoughts”, and “if they’re doing presentations and they’re more comfortable using PowerPoint versus, you know, pen and pencil… it gives them that opportunity… to maybe feel included.”

It appears as though nature-technology integration may promote inclusion, as can be seen through Carol’s example of providing accommodations for students with exceptionalities through the use of technology. This example aligns with Ciampa’s (2014) findings that interactive devices can be used to address the needs of students with multiple learning styles. Secondly, the above interview examples also illustrate that nature-technology integration may be a useful medium for promoting citizenship amongst students. Similarly, in the literature review, it was discussed that schools are essential in helping to shape students into informed and empowered citizens (Ontario Working Group on Environmental Education, 2007). Together, these findings suggest that nature-technology integration may support the learning and development of all students as active and informed citizens.

4.1.3 Participants noted that the integration of nature-based education and technology together increased student engagement in their learning

A significant benefit acknowledged by both participants is that technology enhances student engagement with nature-based education. According to Carol, taking an inquiry approach to nature-based education had been a “culture” at her school for a long time, allowing students to look into environmental topics in their local community that interested them, and she believed that to be a factor contributing to student engagement. Carol also explained that she felt as though technology is a motivational tool for students that “has the potential to enhance any program” and that it is necessary to utilize technology in education because, depending on their
age, students are “all on their phones, they’re all on technology as it is, so when you don’t use it, it’s almost like they’re bored.” Emily added that cameras are tools that allow students to document their memories and ideas, a significant feature that sparks their engagement. She also shared similar views with Carol, as she stated that technology is familiar to most students and “having a device helps them to get into the program more” at her centre, particularly in relation to engaging older students as well as those who did not appear interested in nature-based education when they arrived at the centre. She affirmed that “Most of the time we see really happy, excited kids. Especially when they learn they’ll be using GPS or cameras, they think it’s really cool” and she explained that “giving them something that’s fun to play with is really beneficial. It helps them to learn better when they have something they’re excited to use.” Further, Emily noted that some students found the GPS program so enjoyable that they asked how they could continue to do the activity at home. To that, Emily provided them with a link to a geocaching website so that they could “take it home and share it with their friends and family.”

Much like what was referenced in the literature, both Emily and Carol found that using a variety of field-friendly technology, like iPads, cameras and GPS units, was beneficial for sparking student engagement in nature-based education and across several curriculum subjects (Beggs et al., 2013). In addition, Emily described results similar to those described in the study by Beggs et al. (2013), which found that students who were given iPads on a nature walk not only remained engaged while on the hike, but wished to return to the site in the future. These examples point to the idea that technology has the potential to sustain students’ connection and engagement with nature-based learning outside of the context of the original programs and classes in which it is presented. Moreover, Emily added additional insights that I had not covered in my review of the literature, suggesting that students share their new learning with family and
friends when they continue to take an interest in nature-technology programming at home, thereby spreading awareness and knowledge about the environment to others who were not directly involved in activities at the outdoor centre.

4.2 Educators Cited That Staff Initiative, Program Goals, and Access to Resources Are Necessary for the Successful Integration of Nature-Based Education and Technology

This theme discusses the factors and resources described by interview participants as those which are most important in assisting educators in integrating nature-based education and technology in their teaching practice. The role of staff initiative and cohesive program priorities in this integration will first be discussed, followed by a reflection about how the Ontario curriculum (OMOE, 2011) can be used as a beneficial resource. Lastly, the significance of equipping schools with a variety of educational spaces and resources for nature-technology integration is elaborated on.

4.2.1 Participants acknowledged that staff initiative and program priorities must be aligned with goals to integrate nature-based education and technology into practice

A supportive factor that Carol named is that staff and administration need to be on board with environmental and technology-based initiatives. At her school in particular, Carol shared that each principal in the school had always been on board and open to new eco-initiatives; however, she cautioned that without such support from staff and administration, it would create a barrier for implementing eco-initiatives. Carol shared that her school is a small community school, and so, the institution attempts to incorporate aspects of the community in their programming. She expressed that eco-action is a priority at her school and the front garden is therefore a main focus. For instance, a shared nature-based initiative in the school is that “each class is responsible for starting their seeds in their classroom and then we have a whole school
wide planting day. We have a community day where we work in our garden on the weekends.”

Another successful example that Carol discussed was that a different teacher in the school took initiative in planting a medicine garden with her class. That experience highlighted one strategy for infusing Indigenous education into the program and having students research the plants needed for the garden, and it also showcased how initiative and collaboration amongst staff supports the infusion of creative nature-based programming.

Carol referenced that part of the school’s vision is to try “to get as much technology as we can into everyone’s hands, especially for the inquiry-based learning.” Emily’s outdoor education center holds a similar shared goal in their drive to integrate technology into nature-based programming, as she explained that:

We wanted to start using GPS at [the centre] because we know it’s a technology that’s becoming more readily available so it’s something kids can use easily and they could take that knowledge back and do it with their families.

Emily further discussed that she was driven to take initiative in incorporating nature-based programming in her own teaching because of her previous educational experiences. She cited that, during an alternative practicum she completed in Hawaii, she noticed that students were very connected to nature and “that inspired me to want to create new programs, get kids knowing and involved in their environment.” When asked about her personal experiences with technology, Carol stated that “technology has sort of always been in the background for me so I’ve always been very comfortable with technology myself”, as her educational background was in radio and television as well as multimedia. For Carol, she explained that this comfort and interest in using technology has allowed her to keep an open mind about utilizing new technology to enhance her programming across all subject areas.
Overall, the examples shared by both Emily and Carol help to showcase the importance of having shared program priorities within educational institutions as well as dedicated administration and staff members who will take initiative in achieving those goals. One article in the literature review did, however, offer an alternative perspective to that of the participants’ positive examples, as it brought to light the issue that some school administrators in one study lacked knowledge about technology and, therefore, did not feel confident in their ability to support technology integration within their schools (Leonard & Leonard, 2006). This is significant in that it speaks to the issue that some administrators may not feel prepared for working towards nature-technology integration, and these initiatives may therefore be impacted by a lack of necessary support and guidance from such stakeholders.

### 4.2.2 One participant reasoned that expectations outlined in the Ontario curriculum support the integration of nature-based education and technology together

One factor that has been addressed as being a significant factor that contributes to the success of integrating nature-based education and technology together in education is ensuring that expectations relating to technology and nature are mandated by the school board. In particular, Carol positioned the Ontario curriculum (OMOE, 2011) as being one such document that promotes nature-based education and technology integration within schools.

Carol explained that a shift took place in education when media studies became a big part of the language curriculum, as “media of course involves a lot of technology.” She expressed that all educators “had to sort of embrace technology to a certain point”, and so, the emphasis placed on integrating media within the curriculum helped to encourage Carol to add more technology into her own lessons. For example, she described combining media and environmental education to create posters about pollution. Moreover, there is a teacher-librarian
at Carol’s school who collaborates with educators to co-create lessons that incorporate media and technology together in order to better support teachers who are not yet comfortable in their ability to do so.

Carol also briefly spoke to the new science curriculum as being highly supportive of the inclusion of nature-based education in schools, as she explained that environmental topics are now discussed at the forefront of the curriculum, so “as teachers, you kind of have no choice but to sort of get into the environment stuff.” This newly mandated portion of the curriculum, combined with the emphasis on incorporating media and technology in education, is therefore beneficial in making the integration of nature-based education and technology together a realistic and clearly defined goal for educators to achieve.

Much like Carol described, a review of the Ontario curriculum (OMOE, 2011) document emphasizes that both environmental education and technology integration are priorities for all schools to incorporate. Specifically, one of the Ontario Ministry of Education’s (2011) future goals is to ensure that environmental education is included across all grades and subjects, and the policy currently describes some expectations for educators to refer to when integrating nature-based learning and technology in their teaching. Alternatively, it was uncovered in the literature that many educators feel as though the curriculum is overcrowded with expectations, making it difficult to find space to incorporate environmental education in their teaching. Although the curriculum is a useful document that may help to support nature-technology integration, further research would need to be done in this area to determine how to better support educators in overcoming such a challenge so that environmental education receives adequate attention in schools and nature-technology integration can become a feasible priority.
4.2.3 Participants recognized the importance of access to varied educational spaces and resources as factors essential in integrating nature-based education and technology together

Carol emphasized the fact that her school has created a number of educational environmental spaces that are used as resources and learning tools with the students. For example, she described that every year the eco-team plants a footprint garden as one of the ‘greening’ initiatives on the school grounds. A local non-profit organization originally helped the school to start the garden, providing the school with resources and conducting workshops with the students. Educators at Carol’s school can also make use of the butterfly garden, the nature study zone, the path system that connects the school to nearby park spaces, or even the local botanical garden. Carol also mentioned that she has used the book *Natural Curiosities* as a resource and she noted that it was shared with all of the teachers at her school in order to support them in learning how to incorporate nature study in their teaching.

Emily expressed that the outdoor education centre she works at has access to an abundance of natural educational spaces and resources as well. She described having access to the field centre for indoor learning experiences, as well as the ability to explore a wetland within the conservation area. She also discussed that insect pin boards, animal furs and skulls are additional resources that students are given opportunities to study. Outdoor spaces are routinely used for conducting programming that integrates nature-based education and technology, as Emily described geocaching programs in which students use GPS units to study the watershed and answer questions about water or biodiversity along the way.

During her interview, Carol also explained the importance of making technology readily accessible to educators in order to aid in the integration of nature-based education and
technology. She described that her school has access to a wide variety of technological resources and every class has access to some technology. For instance, there are ten to twelve digital cameras in the school, the computer lab has twenty computers, each primary class has five iPads, junior classes have chrome books, some classrooms have smartboards, each class has a projector, and all schools in the board have access to wifi. According to Carol:

It’s the matter of getting the tools in your hands, so once we started getting iPads in the classroom is when I started to incorporate more technology in nature study because it made it easy, made it easy to take an iPad out. Let’s go out for a walk, here’s our focus, this is what we’re looking for and this is what we’re doing. So that really helped once we got the iPads.

Carol also explained that primary teachers used to have to go downstairs in the school to sign out iPads for use in their classes, and that many teachers would thus avoid using the technology; however, as Carol further stressed, “This year they are in your classroom. You need to try to use them, so we’re hoping that putting the technology into classrooms where it’s there all the time makes less work than going downstairs.” This suggests that perhaps educators will be inclined to incorporate technology in their teaching, and more specifically within nature-based education, when it is more easily accessible to them, thus helping to overcome a challenge associated with lack of accessibility to technology.

In response to her discussion that a lack of training in using technology becomes a barrier to integrating its use within nature-based education, Carol expressed that educators “need those little sessions, like either a Lunch-and-Learn or after school sessions” to support their efforts in nature-technology integration. She then shared that the school board offers online training sessions for educators, such as learning how to use Google Classroom; although, she admitted
that educators have to take initiative to sign up for the sessions which has the potential to create a barrier if teachers are not interested in doing so. Carol also explained that the school board offered several after-school workshops about nature-based education which helped to spark her interest in the topic and allowed her to observe how other teachers integrated nature study in their programs.

Both participants listed various natural spaces that they have access to in their practice and they described that there are a number of benefits and uses for such spaces. Similarly, the literature emphasizes that having access to outdoor spaces is critical for ensuring that students develop connections with their local communities through authentic experiences (Working Group on Environmental Education, 2007). In relation to the importance that Carol placed on proper training for nature-based education and technology, Beggs et al. (2013) also suggested that providing educators with professional development opportunities can increase their confidence in utilizing technology in their teaching practice; however, as Carol explained, her school board offers a number of professional development opportunities, but that it is up to educators to take initiative in participating in the voluntary workshops. A limitation exists in the research then that should aim to address how educators can be further motivated to take initiative in utilizing the number of training resources that are available to them, not just regarding the use of technology, but within nature study as well. It appears as though it is not enough to provide educators with spaces and resources necessary for nature-technology integration, or within any other subject for that matter. Perhaps administrators may need to look into how staff can then be motivated to make use of such resources including outdoor spaces, technology, and professional development opportunities.
4.3 Educators Interviewed Agreed That There Are Challenges and Barriers Associated with Resources and Staff Initiative That Stand in the Way of Integrating Nature-Based Education and Technology Together in Their Practice

This theme seeks to address the interview participants’ perceived challenges and barriers to integrating nature-based education and technology together. This theme is significant, as it will attempt to identify some of the major hindrances to the successful integration of nature-based education and technology together, providing insight into areas that may require future improvement. The following subthemes will discuss the implications of a lack of access to natural spaces and technological resources, a shortage of student and staff interest and participation in nature and technology initiatives, and educators’ insufficient knowledge about technology and environmental education.

4.3.1 Participants acknowledged that a lack of access to outdoor spaces and reliable technology hinder the integration of nature-based education and technology

A lack of access to outdoor spaces was described as one of the major barriers to incorporating nature-based learning opportunities in schools, which would, in turn, impact effective nature-technology integration. Emily described that many students come to her program that have never been in a forest before, and so, she elaborated that “I know it must be a challenge for many teachers to get outside.” As Carol pointed out, attempting to improve school green spaces can be a challenge, as there are a lot of design consultations and much paperwork involved in the process. An additional barrier that Emily explained is that outdoor education centres are not always advertised well to schools, and so, educators who do not have access to green spaces at their schools are also unaware of the variety of outdoor spaces available to them outside of the school grounds. Furthermore, Emily spoke to the fact that field trips to outdoor
education centres are costly for schools, as her program costs an average of three hundred and fifty dollars per school bus, thus hindering many schools, and those in lower-income neighbourhoods in particular, from utilizing such programs. On a similar note, cost presents a further challenge in Emily’s program, as she argued that “To get new materials to discuss nature and the environment in the classroom is going to cost money, and obviously we don’t have that right now” and also that “it was difficult trying to see what would fit in the budget that would be an interesting technology.”

Carol touched upon the idea that technology becomes a barrier when it is not reliable. For example, she explained that difficulties arise when teachers lose connection to the school wifi, therefore preventing educators from implementing technology-based lessons that they had planned. She further discussed that, when such issues occurred, many “teachers were very easy to give up” and were reluctant to continue integrating technology in their lessons because of the perceived challenges and time spent dealing with such problems. Specifically in relation to integrating nature-based education and technology, Emily contributed that bad weather significantly affects how technology works, and solving such issues during lessons “disrupts the flow of teaching”, as cold weather often causes the digital cameras to malfunction and the batteries in the GPS units to drain quickly. At one point, Emily shared that the photography program had to be swapped to a drawing program in cold weather. Overall, she stated that “technology has problems, and sometimes it harms [the students’] experience. It can be a major problem.”

The research literature provided many direct connections to the barriers defined by Carol and Emily. The issues described in relation to poor wifi connections are comparable to those discussed in a study by Beggs et al. (2013), which found that wireless access in schools is often a
challenge many educators face, and such problems not only affect student learning, but also dissuade teachers from continuing to integrate technology in their lessons. Moreover, Emily noted that many educators are unaware of the availability of outdoor education centres, a barrier that is consistent with Ernst’s (2014) suggestion that educators often perceive a lack of access to natural spaces in local settings. These findings suggest that, if nature-based education and technology are to be successfully integrated together, educators need to be provided with easy access to both outdoor environments and reliable, affordable technology. As was suggested by Carol in an earlier subtheme, access to iPads made integrating technology into nature-study much easier for her. It can then be speculated that other educators may also be more likely to integrate both disciplines if they have reliable access to technology, as well as to an abundance of natural spaces in which to conduct such integration.

4.3.2 Participants addressed that a lack of student and staff participation and initiative are barriers to the integration of environmental education and technology

Carol expressed that a lack of student interest in initiatives like eco-clubs can also be a challenge in schools. For instance, in previous years, there was not as much interest from students in the upper grades participating in the eco-club at Carol’s school, and so, the club had to expand to include Grade 2 students in order to ensure that there was enough support. Similarly, Emily expressed that “There are always those kids that, on field trips, are a stick in the mud”; however, she went on to explain that technology often increases students’ engagement in the program with exciting tools that they know how to use, and “those kids always have the biggest difference when you use technology.” Emily also suggested that demographics play a role in determining student participation in nature-based activities, as a barrier that she has encountered is that some students who live on farms up north are “a little less interested because
they’re outside all the time.” Additionally, Emily described one situation in which a student was disappointed that the cameras used in the nature photography program were not DSLR cameras, but rather that they were simple point and shoot devices without many specialized photography features. As she further explained, such an occurrence may cause students to lose interest in the program, as the experience or simple technology provided is not what the students had expected.

Carol spoke to the challenges associated with getting staff involved in integrating nature-based education and technology in their practice. She communicated that “as long as you have admin on board and other staff that are willing to sort of embrace it, it’s great, but if you don’t have those, those are definitely some barriers.” One such challenge she indicated was that many educators have been teaching without technology for a number of years and are not interested in starting to use technology in their practice now. Similarly, Carol explained that “not everyone has that knowledge of how to incorporate nature-based…learning in their programs” either, making it difficult for some educators to incorporate environmental education in their teaching. Emily shared comparable remarks, adding that there are “a lot of teachers that just aren’t interested. They have their subject or they have their grade level and that’s just what they want to do, they’re not interested incorporating something that may be an abstract idea to them.”

Described above, Emily’s difficulties engaging a student with technology was reflected in a study by Begg’s et al. (2013) in which some school boards described that technology had no positive effects on improving student engagement in learning and that not all students took an interest in using the particular technology available to them. These findings speak to the idea that, although technology integration can be an engaging strategy for many students, the context in which it is applied and the types of technology used may not always be successful in increasing student interest in nature-based education. Additionally, as Carol and Emily
explained, some educators are unsure of how to incorporate nature-based learning in their teaching as well. This is consistent with literature that suggests that many teachers and preservice educators have not received formal training in environmental education, which may in turn impact their willingness to integrate nature-based learning in their practice, and even more so with technology (Ontario Working Group on Environmental Education, 2007; Spence, Wright & Castleden, 2013). This addresses a limitation within current research, as there is limited information on whether staff initiative in integrating nature-based learning and technology together would increase if educators were provided with formal training in both disciplines.

4.3.3 Participants discussed that a challenge for some teachers is overcoming a lack of knowledge about how to teach environmental education and technology

Aside from the issue of a lack of staff initiative in integrating nature-based education and technology, Carol and Emily discussed the barriers associated with a lack of knowledge about how to teach such topics. For instance, Emily stated that:

I think if the teacher doesn’t have any background in nature, introducing any sort of nature-based learning, let alone technological background, would be challenging. Teachers that are keeners would be doing it anyways, but…It’d be like pulling teeth for someone not trained in it.

A related argument from Carol is that “having [technology] in there and not training the staff on it is not beneficial to the students in that class, it’s just going to sit there and do nothing”, pointing to the importance of ensuring that staff are properly trained and equipped to integrate such materials and practices into their classrooms. On the other hand, similar to the challenges addressed in the subtheme above, Carol further explained that teachers must take initiative in learning about technology integration and to sign up for training sessions, remarking that “it’s all
about the want of the staff within the school. If you have staff that are interested, great. If you don’t, then that’s a barrier.”

Carol also spoke to the idea that a lack of teacher collaboration could also pose a challenge for the integration of nature-based education and technology because “if [teachers are] in sort of their own classroom and not seeing what other teachers are doing, I don’t think they’ll have the same comfort level”, suggesting that sharing information and lesson plans may be necessary to help educators become knowledgeable in this area. Moreover, receiving support from other sources, such as the Eco Schools organization, was also described as valuable; however, Eco Schools is a growing initiative, and so, Carol conveyed that schools cannot receive as much individual support from the organization as in previous years simply because there are many more schools currently participating. For this reason, Carol clarified that it can be difficult for educators to access resources and knowledge from Eco Schools.

The importance of knowledge and training in nature-based education and technology, as described by Emily and Carol, was also discussed in the literature. In some cases, many teachers admitted to having very little formal instruction about how to teach environmental education (Spence, Wright & Castleden, 2013), and others spoke to the need for guidance and opportunities to collaborate with others in relation to learning how to integrate technology in their teaching (Beggs et al., 2013). For these reasons, ensuring that educators become knowledgeable in these areas is a significant barrier that must be addressed in order for the successful integration of nature-based education and technology together in teaching.

4.4 Conclusion

Throughout this chapter, I organized and discussed my research findings in four main themes and related subthemes. I began with a discussion regarding the benefits of nature-
technology integration in relation to academic applications, and students’ socio-emotional development and engagement. In the following theme, I spoke to the need for shared program goals, staff initiative and access to resources in supporting the effective integration of nature-based learning and technology. Finally, I discussed the challenges that the interview participants highlighted as barriers to nature-technology integration in their practice regarding a lack of resources and staff initiative. Many of the participants’ conclusions were consistent with much of what was uncovered in the review of existing literature, including many of the obstacles they face in integrating nature-based education and technology together, as well as some of the outcomes that they observe in their students. The findings are significant, as the participants built on the existing literature through the discussion of strategies that they used in their practice in order to foster the integration of nature-based education and technology, and the challenges that arose during this process. For instance, Emily’s discussion of her use of GPS technology within a nature-based geocaching activity provides insight into a unique strategy for nature-technology integration, of which there is limited literature with concrete examples for achieving such integration. Moreover, Carol spoke to a potential issue regarding a lack of staff initiative for participating in professional development opportunities, which points to an area that requires more consideration in further research literature. In Chapter 5, I discuss the implications of my findings and make recommendations for the continued integration of nature-based education and technology together in educational contexts.
Chapter 5: Implications and Recommendations

5.0 Introduction

In this chapter, I discuss the implications and significance of this study, beginning with a review of my key findings in relation to the research question, “how is a small sample of primary/junior educators in Canada integrating nature-based learning and technology together to support students’ learning and development, and what outcomes do they observe from students?” I discuss the implications of these findings for the educational community and for myself as a teacher and researcher. I then make further recommendations for effective nature-technology integration. Finally, I propose directions for future research in this area.

5.1 Overview of Key Findings and Their Significance

The findings from this study were organized into three overarching themes regarding the benefits of, factors and resources necessary for, and challenges and barriers associated with the integration of nature-based learning and technology together. The following is a brief overview of my key research findings and discussion points.

Although one of the goals of this study aimed to discern whether the integration of nature-based education and technology would contribute to positive outcomes for students, neither of the educators interviewed spoke to observed academic outcomes. Instead, both teachers agreed that there are cross-curricular academic applications that can be made through nature-technology integration. For instance, along with supporting inquiry-based learning for students, Carol and Emily discussed their ability to make connections with art, science, social studies, and health and physical education through the integration of nature-based education and technology. As an example, both educators described using nature-technology integration to explore nature photography and the seven elements of design. Each educator also expressed that
nature-technology integration allows students to experience a deeper connection to the environment and a sense of citizenship. Carol also pointed to the ability to support students with exceptionalities in environmental studies through the use of various technologies. Finally, engagement in learning was cited as a benefit of nature-technology integration. As Emily explained, students at her centre get excited about using GPS or cameras, and that excitement contributes to their learning and desire to participate in similar activities outside of the program.

Staff initiative and program priorities were highlighted as factors necessary for the successful integration of nature-based education and technology. Carol explained that the principal and teachers at her school are supportive of nature-based initiatives and technology integration, making it easier to include both in educational programming. Emily and Carol also shared that their personal backgrounds influenced them to include nature-based learning and technology in their practices. Carol’s prior education allowed her to become comfortable using technology in her teaching, while Emily described that her passion for nature-based education stemmed from an alternative practicum experience in Hawaii. Lastly, resources like the Ontario curriculum, access to outdoor spaces and technology, and professional development sessions were listed as factors that support nature-technology integration. For example, Emily described that GPS units allow her students to explore biodiversity in a local watershed. Similarly, Carol discussed her increased use of technology in nature study as a result of access to iPads, and she spoke of the need for educators to take initiative in attending training workshops to improve their ability to apply nature-technology integration in their teaching.

This study explored many barriers to the integration of nature-based education and technology, of which, literature and interviewees pointed to a lack of access to natural outdoor spaces and reliable technology as two of the biggest challenges (Ernst, 2014; Beggs et al., 2013).
Emily explained that many schools do not have access to outdoor spaces, and outdoor education centres are costly and under-advertised in schools. Technology was also described as an expensive investment, and some technology can be unreliable. When technology poses problems, Emily and Carol shared that it hinders student learning and teacher willingness to continue using it, especially when integrating it with nature-based experiences. Moreover, a lack of student and staff interest in nature-based learning or available technologies were also posited as challenges with the integration of both disciplines, and educators who do not feel knowledgeable in teaching environmental education or technology were described as less likely to incorporate either into their practice.

5.2 Implications

In this section, I discuss the implications of my research study for the educational community, as well as for myself as a teacher and a researcher.

5.2.1 The educational community

During the interview process, Emily noted that outdoor education centres are not advertised well to schools and educators may be unaware of the nature and technology-based resources that are available to them through such facilities. This point addresses a significant gap that I had not uncovered in literature regarding a need for school boards to better supply and promote resources to schools. If teachers are unaware of the resources available that will help them to integrate nature-based learning and technology together, then it may become more difficult for them to do so in their own practice.

Another finding of this study is that participants perceived that some educators have a lack of comfort and knowledge about teaching environmental education and technology, which
may hinder their willingness and ability to integrate both together in their teaching. Based on this gap, recommendations for increasing teacher knowledge in this area will be explored later.

To continue, faculties of education may be instrumental in adequately preparing educators to adopt nature-technology integration in their practice. For instance, both interview participants described the impact that prior experiences had in driving them towards integrating nature-based learning and technology together. This suggests that it is not enough to provide workshops and training to in-service teachers, but rather that pre-service educators may benefit from opportunities to learn about nature-based education and technology integration prior to becoming certified educators. There may be a need then for faculties of education to equip pre-service teachers with such experiences so that they may be more likely to integrate nature and technology in their teaching.

As was found in research literature and through participant interviews, ministries of education, school administrators, and teachers all play a large role in the successful integration of nature-based education and technology. If these bodies are not consistent in their support of nature-technology integration, then it is likely to negatively impact how well such initiatives are incorporated into schools. This is significant in that it highlights the need for collaboration amongst these stakeholders and clear goals for nature-technology integration.

Finally, both interview participants discussed that there are many cross-curricular and inquiry-based connections that can be made through nature-technology integration. This finding is consistent with research literature, suggesting that nature-technology integration has a significant role to play in education, linking curriculum subjects together through the lenses of environmental education and technology. It is therefore important for teachers, administrators and ministries of education to be aware of the strategies and tools available that will assist
educators in meeting curriculum expectations and introducing students to an abundance of information through the integration of nature-based education and technology with their classes.

5.2.2 My professional identity and practice

Through completing this study, I have learned much about the integration of nature-based education and technology, including the benefits and challenges that this work entails. When I first began to research this topic, it was difficult to find literature about nature-technology integration, as much of the research looked at each discipline separately. For this reason, I will continue to be an emerging voice in the area of nature-technology integration in the future so that others may benefit from what I have learned. I have become aware of strategies for using technology within environmental education, both inside and outside of the classroom, and I will continue to read new research as it becomes available so that I may use such tools and strategies in my own teaching. I will make certain to share my insights with others in the educational community in order to spread awareness of the possibilities of nature-technology integration.

Aside from reading into current literature about nature-technology integration, I will also aim to seek professional development regarding environmental education and technology, as I have come to understand that such opportunities may increase my own confidence in integrating nature-based learning and technology together. To this end, I will also be a promoter of this integration in my own future career setting, such as by advocating for access to technology and green spaces, and by explaining the significance of nature-technology integration to other educators.
5.3 Recommendations

In this section, I make recommendations for the effective integration of nature-based learning and technology together with consideration to various stakeholders including school boards and ministries of education, schools and teachers, and faculties of education.

5.3.1 School boards and ministries of education

There is a need for educators to be better aware of outdoor centres and programming that are available to them. A recommendation to address this need is for school boards to advertise such programming more in schools so as to ensure that teachers recognize the resources that they have access to. Once teachers are made aware of such resources, they may therefore be better equipped to include nature and technology-based programming opportunities for their students.

To continue, educators also need opportunities to develop their skills and knowledge in the areas of environmental education and technology. As was explained by Carol, her school board offers many workshops to train teachers about how to use various technologies, and she collaborates with other schools and agencies for ideas to improve eco-initiatives at her school. It is therefore my recommendation that school boards ensure adequate training and workshop opportunities for educators in the areas of technology and environmental education to make sure that teachers feel prepared to integrate nature-based learning and technology in their practice.

As has been observed in the literature and in my participants’ interview responses, support from ministries of education is crucial for effective nature-technology integration. For this reason, my recommendation is that ministries of education set goals in place that mandate for educators to integrate nature-based learning and technology together in their practices. Although there are some aspects of environmental education and technology discussed in current Ontario curriculum documents, the Ontario Ministry of Education could build on the existing
foundation to set out curriculum expectations more specific to nature-technology integration. In this way, educators may be more motivated to incorporate such practices into their own teaching, as nature-based education and technology integration would be a required expectation to follow.

5.3.2 Schools and teachers

As principals have some influence to set the overall tone for a school’s individual initiatives, it is essential that administrators become aware of the benefits of nature-technology integration and support school-wide initiatives that aim to incorporate nature-based learning and technology in schools. Alternatively, as was explained in the literature, some administrators do not feel confident in their ability to be technology leaders in their schools (Leonard & Leonard, 2006). To overcome this challenge, my recommendation would be to supply administrators with opportunities to enhance their skills in technology integration, and also in environmental education, so as to help improve their confidence and willingness to act as role models in the integration of nature-based learning and technology in their schools.

There is a clear need for educators to take initiative in integrating nature-based education and technology in their teaching, as well as in seeking out professional development opportunities to improve their skills and confidence in this approach. A recommendation then would be for teachers to ensure that they set time aside to participate in professional development sessions regarding environmental education and technology, and to collaborate with educators who are knowledgeable in these areas. Moreover, if such opportunities for learning and skill development are not offered, I would also recommend that educators advocate for school boards to provide them with adequate training and resources for nature-technology integration.
Teachers who are passionate about the integration of nature-based education and technology should also share their insights with others in the educational community. Whether through leading workshops, online blogs, writing for academic journals and magazines, or simply conversing with their colleagues, teachers should communicate about their learning, useful resources and teaching strategies so as to better inform other educators who wish to integrate nature-based learning and technology in their practices as well.

5.3.3 Faculties of education

Faculties of education can play an important role in preparing pre-service educators to integrate nature-based education and technology in their future practice. As an extension, I would thus recommend that faculties of education strive to provide pre-service teachers with courses and learning experiences dedicated to nature-based education and technology, as such opportunities may motivate pre-service teachers to incorporate such practices in their future teaching.

5.4 Areas for Further Research

When discussing opportunities for professional development in regards to technology integration, Carol explained that teachers are not obligated to participate in such learning sessions, and that teachers instead must take the initiative to engage in voluntary workshops. A question that remains then is, how can teachers be further motivated to take initiative in utilizing the training resources that are available to them to ensure that they feel confident in their ability to integrate nature-based learning and technology together? A direction for further research then would be to look into how schools boards, ministries of education, and administrators can encourage teachers to seek professional development in this area. Secondly, an issue addressed in this study is that some educators may discontinue using technology in their lessons if it proves
challenging or unreliable. Future research could thus explore how to overcome these obstacles to ensure that teachers do not become de-motivated to use such tools if they encounter problems.

To continue, personal background experiences appeared to influence my participants’ willingness to integrate environmental education and technology in their practices. Further research could be done in this area to determine whether or not prior experience and education is a determining factor in teachers’ uses of nature-technology integration. Moreover, researchers could investigate if there are benefits associated with providing pre-service educators with nature and technology-based learning experiences, and whether such experiences would motivate pre-service educators to continue nature-technology integration in their future teaching.

Finally, one of the aims of this study was to uncover whether the integration of nature-based education and technology was associated with students’ academic outcomes. One of the interview participants was unsure if there were immediate academic benefits for her students, and she suggested that the outcomes would develop more over time with students’ continued exposure to nature-technology integration. For this reason, an area for further research would be to explore if there are indeed immediate or gradual academic outcomes for students associated with an increased integration of nature-based learning and technology in schools.

5.5 Concluding Comments

To conclude, my research study found that there are many benefits associated with the integration of nature-based education and technology, particularly in the areas of socio-emotional development, academic applications and engagement. As was discussed above, there are many opportunities for educators to create cross-curricular connections between nature-technology integration and other subject areas, and many technologies have the potential to spark excitement and a deeper understanding of the natural environment in students. This chapter also discussed
some of the many supports and resources that have been found to be instrumental in helping educators to effectively integrate nature-based education and technology together. For instance, supportive administration and professional development sessions were described as necessary factors in nature-technology integration. Other findings included some of the barriers to this integration, such as a lack of access to natural settings and technology, as well as a lack of student and staff interest in natural or technological tools and experiences.

This chapter aimed to uncover some of the implications and recommendations for various stakeholders in the educational community and for myself as a teacher and researcher. Implications for ministries of education, administrators, and teachers were addressed, such as gaps in teacher knowledge about the integration of nature-based learning and technology together, as well as the need for pre-service teacher training and collaboration amongst various stakeholders. I then explained how what I have learned through this study will impact my future teaching practice. Specific recommendations to address many of the aforementioned implications were then discussed for each of the affected stakeholders, including recommendations that may help all stakeholders work towards a collaborative, shared vision for the integration of nature-based education and technology together. For instance, it was suggested that ministries of education mandate expectations for nature-technology integration, while administrators and teachers attend professional development sessions to increase their knowledge and skill base in this area. Overall, the findings of this research study suggest that the integration of nature-based learning and technology has much potential within the field of education. There are still many challenges to overcome in relation to successful nature-technology integration; however, current literature, participants’ interview responses, and my own recommendations point to areas for improvement that may help to ensure the effective integration of both disciplines in the future.
References


Appendix A: Letter of Consent for Interviews

Date:

Dear _______________________________,

My Name is Lisa Cole and I am a student in the Master of Teaching program at the Ontario Institute for Studies in Education at the University of Toronto (OISE/UT). A component of this degree program involves conducting a small-scale qualitative research study. My research will focus on how elementary educators are integrating nature-based learning and technology in the classroom. I am interested in interviewing K-8 educators who have access to various forms of technological resources and natural outdoor settings, and who have a commitment to integrating nature and technology together in their teaching practice. I think that your knowledge and experience will provide insights into this topic.

Your participation in this research will involve one 45-60 minute interview, which will be transcribed and audio-recorded. I would be grateful if you would allow me to interview you at a place and time convenient for you, outside of school time. The contents of this interview will be used for my research project, which will include a final paper, as well as informal presentations to my classmates. I may also present my research findings via conference presentations and/or through publication. You will be assigned a pseudonym to maintain your anonymity and I will
not use your name or any other content that might identify you in my written work, oral presentations, or publications. This information will remain confidential. Any information that identifies your school or students will also be excluded. The interview data will be stored on my password-protected computer and the only person who will have access to the research data will be my course instructor Angela MacDonald-Vemic. You are free to change your mind about your participation at any time, and to withdraw even after you have consented to participate. You may also choose to decline to answer any specific question during the interview. I will destroy the audio recording after the paper has been presented and/or published, which may take up to a maximum of five years after the data has been collected. There are no known risks to participation, and I will share a copy of the transcript with you shortly after the interview to ensure accuracy.

Please sign this consent form, if you agree to be interviewed. The second copy is for your records. I am very grateful for your participation.

Sincerely,

Lisa Cole

Lisa.cole@mail.utoronto.ca

Course Instructor’s Name: Angela MacDonald-Vemic

Contact Info: angela.macdonald@utoronto.ca
Consent Form

I acknowledge that the topic of this interview has been explained to me and that any questions that I have asked have been answered to my satisfaction. I understand that I can withdraw from this research study at any time without penalty.

I have read the letter provided to me by Lisa Cole and agree to participate in an interview for the purposes described. I agree to have the interview audio-recorded.

Signature: ______________________________________

Name: (printed) _______________________________________________

Date: ______________________________________
Appendix B: Interview Protocol

Thank you for agreeing to participate in this research study and for making time to be interviewed today. This research study aims to learn how educators in primary/junior settings integrate nature-based learning and technology together in the classroom to promote engagement and learning for all students, and to gain insight into the outcomes that they observe from their students. The purpose of this is to inform elementary educators about the benefits and strategies necessary for integrating nature and technology in schools to assist in teaching curriculum content and helping all children to achieve better learning outcomes. This interview will last approximately 45-60 minutes, and I will ask you a series of questions focused on your perspectives, beliefs, practices, supports, challenges and next steps regarding the integration of nature and technology in your teaching practice. I want to remind you that you may refrain from answering any question, and you have the right to withdraw your participation from the study at any time. As I explained in the consent letter, this interview will be audio-recorded. Do you have any questions before we begin?

Background Information

1. How long have you been an educator?

2. What is your current position?
   - What grades and subject areas do you currently teach?
   - Which have you taught previously?
   - Do you have any other roles in your school? (e.g. coach, advisor, councilor, tech support)

3. Can you tell me more about your school? (e.g. size, demographics, proportion of students with special needs, program priorities)
   - Does your school have any special programming related to outdoor and environmental education? (e.g. member of eco-schools, green roof, school gardens, environment club, etc.)
• Does your school have any special programming related to technology integration? What technology is available in your school?

4. What experiences have contributed to developing your interest in, and preparation for teaching, nature-based learning?

• Personal experiences? (e.g. own experience in K-12, family influence, personal interest)

• Educational Experiences? (e.g. university course work, teachers college, additional qualifications, professional development)

• Professional experiences? (e.g. employment positions, teaching experience)

5. How long have you been integrating nature-based learning in your teaching practice?

6. What experiences have contributed to developing your interest in, and preparation for, technology-integration in teaching and learning?

a. Personal experiences? (e.g. own experience in K-12, family influence, personal interest)

b. Educational Experiences? (e.g. university course work, teachers college, additional qualifications, professional development)

c. Professional experiences? (e.g. employment positions, teaching experience)

7. How long have you been integrating technology into your teaching practice?

8. When did you start to bring these foci together in your teaching practice? How long have you been integrating nature-based learning and technology as instructional tools?

Teacher Perspectives/Beliefs

1. What does nature-based learning mean to you? How do you understand this term? What kinds of experiences do you include/exclude from this?
2. What do you believe is the role of nature-based learning in schools? Why is it important to create opportunities for nature-based learning in schools? What are some of the benefits?

3. In your experience, is it common for schools and teachers to include opportunities for learning that are nature-based? Why do you think that is?

4. What barriers do you think stand in the way of increased opportunity for nature-based learning in schools?

5. And what about technology? What do you see as the benefits of technology integration in learning?

6. Do you have any concerns about the extent that students today spend time on their devices? If yes, what are your concerns? If no, why not?

7. What does “technology integration” mean to you?

8. In your view, is this being effectively implemented in schools? Why/why not?

9. What do you believe is the potential of integrating nature-based learning and technology and why?

10. What do you see as the principle benefits of using nature and technology for teaching and learning?

11. At what age, or in what grade, do you believe integrating nature and technology should be introduced to students and why?

12. Do you perceive integrating nature and technology together in an educational context to be an overly challenging task for educators to achieve? Please explain why or why not.
Teacher Practices

1. What types of technological and natural resources do you have access to in your teaching practice?

2. How do you integrate nature-based learning and technology in your teaching? Can you give me some examples of how you have integrated nature-based learning and technology together in your teaching?
   - What curriculum were you teaching?
   - What were your learning goals?
   - What opportunities for learning did you create?
   - What resources supported you?
   - How did your students respond? What outcomes did you observe from them?
   - What, if anything, did you assess and why? How did you assess students’ learning?

3. What subject areas do you commonly integrate nature-based learning and technology into and why? (Cross-curricular focus)

5. What range of outcomes have you observed in your students as a direct result of integrating nature and technology together in your practice? *listen first, then probe:
   - Academic outcomes?
   - Engagement in learning?
   - Social-emotional outcomes?

6. Are there particular resources that you rely on and recommend when integrating nature-based learning and technology? (e.g. tools, web apps, devices, guest speakers, field trips etc.)
Supports and Challenges

1. What kinds of factors and resources support you (e.g. school leadership, support from colleagues and parents, access to funding and technology, demographics of students, access to outdoor space etc.)?

2. What types of challenges do you encounter when integrating nature-based learning and technology together in your practice?

3. When you encounter these challenges, how do you respond to them?

4. How could the education system further support you in addressing these challenges?

Next Steps

1. What are your goals for developing your programming in this area? How do you see nature and technology being integrated in classrooms in the future?

2. What advice, if any, do you have for a beginning teacher who is interested in integrating nature-based learning and technology in their teaching?

Thank you for your participation in this research study.